Exhibit 50

Water Desalination

Findings and Recommendations

October 2003

Gray Davis, Governor, State of California
Mary D. Nichols, Secretary for Resources, The Resources Agency
Michael J. Spear, Interim Director, Department of Water Resources

Copies of this Report may be obtained from:

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STATE OF CALIFORNIA – THE RESOURCES AGENCY GRAY DAVIS, *Governor*

DEPARTMENT OF WATER RESOURCES
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October 9, 2003

Mr. E. Dotson Wilson
Chief Clerk of the Assembly
State Capitol, Room 3196
Sacramento, California 95814

Dear Mr. Wilson:

We are pleased to present you with the enclosed Department of Water Resources report, *Water Desalination - Findings and Recommendations* as called for by Assembly Bill 2717, (Chapter 957, Statutes of 2002). This law directed the Department not later than July 1, 2004, to report to the Legislature on potential opportunities and impediments for using seawater and brackish water desalination, and to examine what role, if any, the state should play in furthering the use of desalination technology. As specified in that legislation this report was prepared with significant input from a Water Desalination Task Force comprised of representatives from twenty-seven organizations.

The recommendations are not restricted to legislative actions or other statutory changes. Many can be implemented by State or local agencies without further legislative authorization or mandate. Several of the recommendations draw upon the experience of many agencies and experts, and provide advice and guidance that can be used by those interested in desalination to help facilitate their planning efforts.

The Department believes that the findings will help clarify some of the important issues regarding desalination, and that the recommendations will help to further its use and application, where appropriate, in the State.

If you have any questions about the Water Desalination Task Force or require additional information, please contact Charles Keene, DWR's Executive Officer for the Task Force at (818) 543-4620, or by e-mail at: chuckk@water.ca.gov.

Sincerely,

Michael J. Spear
Interim Director

Enclosure

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Acknowledgements

The Department wishes to acknowledge and thank the Task Force members named in Appendix A and the following individuals for their help in formulating these Findings and Recommendations and for assisting the Department as part of the Task Force process:

- Marsha Prillwitz, Chief of the Office of Water Use Efficiency – California Department of Water Resources

- Fawzi Karajeh, Chief of the Water Recycling and Desalination Branch, Office of Water Use Efficiency -- California Department of Water Resources

- Brian Smith, Chief of the Resources Assessment Branch, San Joaquin District – California Department of Water Resources

- Fethi Benjemaa, Land and Water Use Analyst, Office of Water Use Efficiency – California Department of Water Resources

- Jennifer Wong, Engineer, Southern District – California Department of Water Resources

- Shahid Chaudhry, Engineer, State Energy Conservation and Development Commission

In addition, the Department wishes to acknowledge the contributions of the Bureau of Reclamation, who provided both technical and financial assistance to this effort.

Water Desalination

Findings and Recommendations

Introduction

In recent years, desalination has re-emerged as a viable water supply source in California. In the late 1980s, during a period of extended drought, several localities either considered or built desalination facilities along the California coast. But with the end of the drought, the high cost of desalinated water could not be justified for many of these localities and some closed their desalination facilities. By the late 1990s, however, desalination was receiving renewed interest as demands for water supply mounted and improvements in technology reduced the cost of desalination significantly.

In September 2002, AB 2717 (Hertzberg) was signed into law, directing the Department of Water Resources to convene a Desalination Task Force to "make recommendations related to potential opportunities for the use of seawater and brackish water desalination." No later than July 1, 2004, the Department is to report to the legislature on potential opportunities for and impediments to the use of seawater and brackish water desalination in California, and what role, if any, the State should play in furthering the use of desalination technology. As specified in the legislation, the report was prepared with significant input from the Water Desalination Task Force comprised of representatives from twenty-seven organizations.

The potential for the increased use of desalination in California is significant. The opportunities are great for providing water supply from seawater and brackish water desalination as well as recovering contaminated groundwater. Although most estimate that desalination will contribute less than 10 percent of the total water supply needs in California, this still represents a significant portion of the State's water supply portfolio.

Potentially, desalination can provide significant value and numerous benefits. These include:

- Providing additional water supply to meet existing and projected demands
- Replacing water lost from other sources and relieving drought conditions
- Enhancing water reliability and supplying high quality potable water
- Reducing groundwater overdraft and restoring use of polluted groundwater
- Replacing water that can be used for river and stream ecosystem restoration

Key Findings

The Department identified several key findings related to desalination that help provide the context for evaluating desalination. One of the primary findings is that economically and environmentally acceptable desalination should be considered as part of a balanced water portfolio to help meet California's existing and future water supply and environmental needs. Others include:

General

1. **California's population is projected to increase by 600,000 per year, largely from natural increases (births minus deaths), which will impact demands for potable water supply.**

2. **Some areas of the State have serious groundwater overdraft problems, adding pressure on existing water supplies to meet agricultural and urban demands.**

3. **Every region of California has unmet environmental water needs (e.g., insufficient water availability to meet habitat needs).**

4. **Desalination can provide a reliable supply during California's periodic droughts.**

5. **Properly designed, maintained and operated desalination facilities can produce water of equal or higher quality than from alternative drinking water sources.**

6. **Desalination is receiving increased attention as the cost of desalination decreases and the cost of many other water supplies continues to rise.**

7. **Many communities and water districts are interested in developing desalination facilities as a local, reliable source of water to reduce their dependence on imported water and/or to meet existing or projected demand. Some communities see desalination as a way to reduce their diversions from rivers and streams, thus contributing to ecosystem restoration.**

8. **Technologically, desalination is a proven, effective mechanism for providing a new source of water. A variety of desalination technologies have been applied in many locations throughout the world.**

9. **Energy generation capacity would not be a constraint to implementation of currently proposed desalination projects. California's peak load demand is currently 52,000 MW; currently proposed desalination projects would require approximately 200 MW.**

10. **Because energy is a major cost component of desalination, economic viability of seawater desalination, in some areas, is dependent on the availability of low-cost power.**

11. California is a leader in the development and manufacture of desalination membrane technology.

Brackish Groundwater Desalination

12. Brackish groundwater desalting is an effective means of treating impaired groundwater, providing a safe water supply and providing capacity for additional groundwater storage in areas with suitable hydrogeology.

13. The primary impediment to brackish groundwater desalting is the need for infrastructure that allows environmentally acceptable disposal of the concentrate discharge, which may contain constituents not found in seawater. Where these issues have been solved, brackish groundwater desalting facilities have been successfully permitted.

14. There are currently more than 40 brackish groundwater-desalting facilities in California that generate approximately 170,000 acre-feet per year (counting both reverse osmosis and ion exchange desalting).

15. An additional 30 to 35 brackish groundwater desalting facilities that could generate nearly 290,000 acre-feet per year are envisioned during the next decade.

16. Based on information from existing facilities, brackish water desalination uses on the order of 1,300 – 3,250 kWh of energy per acre-foot, dependent largely on the source water quality, plant capacity, and technology used.

17. The total cost for brackish water desalination, including the amortized costs for planning, designing, and constructing such a facility and the costs for operation (e.g., energy, chemicals, disposal etc) and distribution of product water will be based on site-specific conditions and currently range from $130 to $1,250 per acre-foot.

Seawater and Estuarine Desalination

18. Economically and environmentally acceptable desalination should be considered as part of a balanced water portfolio to help meet California's existing and future water supply and environmental needs.

19. While they vary on a site-specific level, potential impediments to seawater desalination include the environmental impacts associated with the feedwater intake and brine/concentrate disposal. As is the case with many other water management strategies, other potential issues include cost, siting and growth-inducement.

20. With proper design and location of outfalls, brine/concentrate disposal may not be a major impediment to desalination.

21. There are currently 16 permitted seawater desalination facilities that generate approximately 4,600 acre-feet per year of desalinated water in California.

22. An additional 19 seawater and estuarine desalination facilities that could generate about 240,000 acre-feet per year are currently being planned.

23. Estuarine and seawater desalination currently use on the order of 3,260 to 4,900 kWh of energy per acre-foot, dependent on salinity and temperature of the source water.

24. Seawater desalination is more energy intensive, per acre-foot, than brackish water desalination or water recycling. For energy comparison purposes, current desalination systems using reverse osmosis technology require about 30 percent more energy than existing interbasin supply systems currently delivering water to parts of Southern California. Efforts including those supported by the Bureau of Reclamation, U.S Desalination Coalition, and the National Water Research Institute are underway to increase the energy efficiency of desalination through improved membranes, dual pass processes, and additional energy recovery systems.

25. The viability of seawater and estuarine desalination plants may depend on the price of electricity. Where a desalination plant could purchase electricity through non-retail agreements with power generators or marketers the cost of desalinated water should be lower than with utility-supplied power, which is in the range of 8 to 11 cents (retail) per kWh for municipal and investor owned utilities. Direct access agreements do not require that the desalination plant connect electrically to one power plant.

26. Where a desalination plant may purchase power directly from a co-generator, it would not be subject to rate regulation, reducing the cost of electricity. The desalination plant and the host co-generating facility must meet a number of requirements specified in the State Public Utilities Code.

27. The cost for new seawater and estuarine water desalination, including the amortized costs for planning, designing, and constructing such a facility, and the costs for operation (e.g., energy, chemicals, disposal etc), will range from $700 per acre-foot (assuming wholesale energy costs of about 5 cents per kWh) to $1,200 per acre-foot (assuming retail energy costs of about 11 cents per kWh). In addition, there are distribution costs of $100 - $300 per acre-foot.

28. Many proposed seawater desalination facilities are currently planned to be co-located with existing coastal power plants, including several large facilities in Southern California.

29. Advantages to co-locating desalination facilities with coastal power plants using once-through cooling may include: compatible land use, use of the existing infrastructure for feedwater intake and brine discharge, location security, use of the warmed power plant cooling water as the feedwater for the desalination facility, reduction of the power plant discharge thermal plume and the potential to purchase power from the host power plant at prices below retail rates.

30. Co-locating a desalination facility with a coastal power plant may provide a justification for the continued use of once-through cooling technology. Once through cooling technology has well-documented environmental impacts, including impacts on marine organisms.

31. The appropriate State regulatory agencies have indicated that the siting of a new desalination facility, which utilizes any new or existing open water feedwater intakes, will require a current assessment of entrainment and impingement impacts as part of the environmental review and permitting process.

32. An advantage of blending a desalination plant's brine discharge within an existing wastewater discharge may be the reduction of the salinity of the brine discharge and an increase in the salinity of the wastewater discharge to more closely match that of the receiving water.

33. Various technologies exist that may avoid, reduce or minimize the impacts of feedwater intake.

    a. Drawing feedwater from beach wells is one way to avoid the ecological impacts of entrainment and impingement associated with open water intakes; however, the capacity of each well is limited and is subject to local hydrogeologic conditions.

    b. Low velocity intake systems, marine fish screens, sub-floor intakes and appropriate intake pipe design and location are methods that may reduce or minimize impacts of entrainment and impingement associated with open water intakes.

Planning and Permitting

34. Water, including ocean and estuarine water, is a public resource, subject to the public trust doctrine, and should be protected and managed for the public good.

35. The extent to which private companies are involved in the ownership and operation of proposed desalination plants varies widely, from completely private projects that may be regulated by the State Public Utilities Commission, to public-private partnerships, to projects that would be wholly owned, operated and controlled by public entities. The involvement of private companies in the ownership and/or operation of a desalination plant raises unique issues.

36. There are implications associated with the range of public-private possibilities for ownership and operation of desalination facilities. Local government has the responsibility to make the details of these arrangements available to the public.

37. Recently adopted international trade agreements and international trade agreements currently being negotiated may affect how federal, State and

local agencies adopt or apply regulations concerning activities of public agencies or private entities with multinational ties.

38. Desalination proposals are subject to existing regulatory and permitting processes to ensure environmental protection and public health.

39. Environmental justice considerations include the siting of desalination facilities, determining who accrues the costs and benefits of desalination and who has the opportunity to use a higher quality (desalinated) water, and the possible impacts of replacing low-cost with high-cost water.

40. Growth inducing impacts of any new water supply project, including desalination, must be evaluated on a case-by-case basis through existing environmental review and regulatory processes.

41. Each desalination project involves different environmental characteristics, other water supply alternatives, proposed plant ownership/operation arrangements, demographics, economics, community values and planning guidelines.

Major Recommendations

Based on the findings noted above, as well as other information considered by the Department, several recommendations have been advanced to guide the process of evaluating, permitting, funding, and implementing desalination projects. The overarching recommendation considered critical to the advancement of desalination is that desalination projects should be evaluated on a case-by-case basis. Because each facility is essentially unique, given local water supply and reliability needs, site-specific environmental conditions, project objectives, and proposed technology, case-by-case analyses are essential. The Department's other recommendations are:

General

1. **Since each desalination project is unique and depends on project-specific conditions and considerations, each project should be evaluated on a case-by-case basis.**

2. **Include desalination, where economically and environmentally appropriate, as an element of a balanced water supply portfolio, which also includes conservation and water recycling to the maximum extent practicable.**

3. **Ensure equitable access to benefits from desalination projects and ensure desalination projects will not have disproportionate impacts particularly to low-income and/or ethnic communities.**

4. **The State should create mechanisms that allow the environmental benefits associated with transitioning dependence on existing water sources to desalinated water to be realized.**

5. **In conjunction with local governments, assess the availability of land and facilities for environmentally and economically acceptable seawater desalination.**

6. **Results from monitoring at desalination projects should be reported widely for the broadest public benefits. Encourage opportunities to share information on operational data. Create a database and repository for storing and disseminating information.**

7. **Create an Office of Desalination within the Department of Water Resources to advance the State's role in desalination.**

Energy and Environment

8. Ensure seawater desalination projects are designed and operated to avoid, reduce or minimize impingement, entrainment, brine discharge and other environmental impacts. Regulators, in consultation with the public, should seek coordinated mechanisms to mitigate unavoidable environmental impacts.

9. Identify ways to improve water quality by mixing desalinated water with other water supplies.

10. Where feasible and appropriate, utilize wastewater outfalls for blending/discharging desalination brine/concentrate.

11. Compare reasonable estimates of benefits, costs and environmental impacts for desalination with those for other water supply alternatives realistically available to that area.

12. Recognizing the importance of power costs to the costs of desalination, consider strategies that will allow project sponsors to access non-retail power rates.

13. Clarify the applicability of non-retail energy pricing for desalination facilities.

14. Study the energy intensity and rates currently paid for energy used to provide water from various sources including desalination.

15. Study the potential for developing renewable energy systems in California, in conjunction with desalination implementation strategies.

16. Identify ways that desalination can be used in a manner that enhances, or protects the environment, public access, public health, view sheds, fish and wildlife habitat and recreation/tourism.

Planning and Permitting

17. To improve communication, cooperation, and consistency in permitting processes, encourage review processes for each desalination project to be coordinated among regulators and the public.

18. Evaluate all new water supply strategies including desalination based upon adopted community General Plans, Urban Water Management Plans, Local Coastal Plans, and other approved plans that integrate regional planning, growth and water supply/demand projections. Environmental reviews should ensure that growth related impacts of desalination projects are properly evaluated.

19. Ensure adequate public involvement beginning early in the conception and development of desalination projects and continuing throughout planning, design and evaluation processes. Coordinate public notification, outreach and public involvement strategies.

20. If multiple desalination projects are proposed within a region, coordinate development and analysis of these projects, including their benefits and cumulative impacts.

21. For proposed desalination facilities co-locating with power plants, analyze the impacts of the desalination facility operations apart from the operations of the co-located facilities. This will identify the impacts of the desalination facility operations when there are reductions in cooling water quantities. This recommendation is not intended to dictate California Environmental Quality Act alternatives that must be evaluated.

22. When desalination projects propose environmental benefits, identify the assurances that those benefits will be realized.

23. Evaluate the effects of desalinated water on existing water supply distribution systems.

24. Each community should consider the appropriate role, if any, for private companies in a desalination project or proposal. Factors to consider include:
    - the desired extent of public access and public control;
    - the extent to which the public is willing to finance the capital costs of the project and bear the risks of project development;
    - the extent to which a proposed contract between a public and private entity would affect flexibility in operating the facility;
    - the relevant experience and capabilities of the public or private entity;
    - the impact of the various public-private configurations on ratepayers.

25. Private desalination projects, and private developers and plant operators, should be required to fully disclose the same information as a publicly owned and operated facility.

26. To avoid potential international trade agreement violations, no legal standard or regulation should discriminate against an applicant based on ties to multi-national corporations.

27. Investigate the ramifications of designating ocean and estuarine waters in proximity to desalination intakes as drinking water beneficial use.

Funding

28. Provide funding for research and development projects (e.g., feedwater pretreatment, the value and limitations of beach wells for feedwater intake, other technologies to reduce entrainment and impingement impacts, strategies for brine/concentrate management, opportunities for energy efficiencies and application of alternative energy sources and combined energy and desalination technologies).

29. In addition to other eligibility criteria, State funding should give high priority to those desalination projects that provide the greatest public benefits, such as: 1) serve areas implementing all conservation and recycling programs to the maximum extent practicable; 2) demonstrate long-term environmental benefits; 3) avoid or reduce environmental impacts to the extent possible; 4) reduce health risks by improving water quality; and 5) ensure equitable access to benefits from desalination projects and include feasible mitigation for any environmental justice impacts.

Task Force Process

As directed by AB 2717, the Department of Water Resources convened a Water Desalination Task Force comprised of representative of twenty-seven organizations to advise it on the important issues and opportunities for use of desalination in California. Joining the Department as co-chairs of the Task Force were the State Water Resources Control Board, the State Energy Commission, the State Department of Health Services, and the California Coastal Commission. The Center for Collaborative Policy, a program of California State University, Sacramento, assisted with planning and facilitating the Task Force collaborative process.

The first phase of the Task Force process was the preparation of an assessment report, which highlighted the various perspectives on issues identified by the enabling legislation and prospective Task Force members. The first Task Force meeting was convened in May 2003, followed by four two-day meetings (June through September) to discuss the key issues and develop a list of findings and recommendations. Three public workshops were held in Carlsbad, Sausalito, and Monterey, which were also the site of field trips to view different types of existing or proposed desalination facilities. Additional features of Task Force meetings were the preparation of working papers and expert presentations to guide discussions at each meeting.

The work of the Task Force and the Department was ultimately conducted in a much shorter time frame and with significantly reduced funding than originally planned. While this prevented the Department from more fully evaluating the proposed findings and recommendations and identifying possible solutions or approaches to the more significant issues, broad support exists for the findings and recommendations identified.

Appendix A

Task Force Members and Affiliations

Jonas Minton, Chair
California Department of Water Resources

Pete Silva, Co-Chair
State Water Resources Control Board

Tom Luster, Co-Chair
California Coastal Commission

David Spath, Co-Chair
State Department of Health Services

John Sugar, Co-Chair
State Energy Resources Conservation and Development Commission

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Richard Gordon
County Supervisor Association of California

Jared Huffman
Marin Municipal Water District

David Furukawa
National Water Research Institute

Debbie Cook
League of Cities-Huntington Beach

Appendix B

Summary of Task Force Meeting Schedule, Locations and Activities

April 2003: Completion of Issues Assessment Report by the Center for Collaborative Policy (CSU-Sacramento)

May 2003: First Task Force meeting in Sacramento to kick-off the collaborative process, identifying and clarifying the key issues to be addressed by the Task Force.

June 2003: Second Task Force meeting in Carlsbad to address siting, feedwater and brine/concentrate discharge issues; included technical presentations by experts from Scripps Institute and University of California Santa Cruz; included a field trip to the San Diego Water Authority's pilot desalination project in Carlsbad; the first of three public workshops was held.

July 2003: Third Task Force meeting in Sausalito to address energy, economics and technology issues; included technical presentations by experts from the University of California Santa Barbara and the California Energy Commission; included a field trip to the proposed site of the Marin County desalination facility located on San Francisco Bay; the second public workshop was held.

Aug 2003: Fourth Task Force meeting in Monterey to address planning, permitting and public health issues; included field trips to the Monterey Aquarium desalination facility, the City of Marina beach well desalination facility and Elkhorn slough near the site of a desalination facility proposed at Moss Landing; the third public workshop was held.

Sept 2003: Fifth Task Force meeting in Sacramento to revise and finalize findings and recommendations of the Task Force.

Appendix C

AB2717 - Enabling Legislation for the Water Desalination Task Force

Assembly Bill No. 2717
CHAPTER 957

An act to add Section 12949.6 to the Water Code, relating to water, and making an appropriation therefor.

[Approved by Governor September 26, 2002. Filed with Secretary of State September 27, 2002.]

I am signing Assembly Bill 2717, however, I am reducing the appropriation from the Renewable Resources Investment Fund to $100,000.

This bill would require the Department of Water Resources to convene a Water Desalination task force to make recommendations related to potential opportunities for the use of seawater and brackish water desalination. The revenues from the Renewable Resources Investment Fund are below projections and the fund is expected to have a significant shortfall this year. At a time when the state is dealing with a $24 billion shortfall, any available funds should be used for on-going environmental activities and programs now supported by the General Fund that would otherwise be reduced or eliminated.

Studying the potential opportunities and impediments for the use of water desalination is an important step toward helping the state meet its water needs. Therefore, I am directing the Department of Water Resources to explore funding partnerships with interested local and private entities to accomplish this goal.

GRAY DAVIS, Governor

LEGISLATIVE COUNSEL'S DIGEST

AB 2717, Hertzberg. Water: desalination: report.

(1) The Cobey-Porter Saline Water Conversion Law authorizes the Department of Water Resources, either independently or in cooperation with public or private entities to conduct a program of investigation, study, and evaluation in the field of saline water conversion, to provide assistance to persons or entities seeking to construct desalination facilities, and after submission of a written report and upon appropriation from the Legislature, to finance, construct, and operate saline water conversion facilities.

This bill would require the department, not later than July 1, 2004, to report to the Legislature, on potential opportunities and impediments for using seawater and brackish water desalination, and to examine what role, if any, the state should play in furthering the use of desalination technology. The bill would require the department to convene a Water Desalination Task Force, comprised of representatives from listed agencies and interest groups, to advise the department in carrying out these duties and in making recommendations to the Legislature.

(2) Under existing law, the Bosco-Keene Renewable Resources Investment Fund is established for certain purposes. This bill would appropriate $600,000 from the Bosco-Keene Renewable Resources Investment Fund to the department for the purpose of establishing the Water Desalination Task Force and preparing the report required by the bill.

Appropriation: yes.

The people of the State of California do enact as follows:

SECTION 1. The Legislature finds and declares as follows:
(a) There is a clear public interest in ensuring that land and facilities are available for cost-effective seawater desalination.
(b) Recent advances in technology could make seawater desalination a more attractive option for increasing available water supplies.
(c) Additional information is necessary to assess the potential opportunities for seawater desalination in California.
(d) The activities of a water desalination task force are consistent with those activities for which the moneys in the Bosco-Keene Renewable Resources Investment Fund may be used pursuant to Section 34000 of the Public Resources Code.

SEC. 2. Section 12949.6 is added to the Water Code, to read:
12949.6. (a) Not later that July 1, 2004, the Department of Water Resources shall report to the Legislature on potential opportunities for the use of seawater and brackish water desalination in California. The report shall evaluate impediments to the use of desalination technology and shall examine what role, if any, the state should play in furthering the use of desalination in California.
(b) The department shall convene a task force, to be known as the Water Desalination Task Force, to advise the department in implementation of subdivision (a), including making recommendations to the Legislature regarding the following:
(1) The need for research, development and demonstration projects for more cost effective and technologically efficient desalination processes.
(2) The environmental impacts of brine disposal, energy use related to desalination, and large-scale ocean water desalination.
(3) An evaluation of the current regulatory framework of state and local rules, regulations, ordinances, and permits to identify the obstacles and methods to creating an efficient siting and permitting system.
(4) Determining a relationship between existing electricity generation facilities and potential desalination facilities, including an examination of issues related to the amounts of electricity required to maintain a desalination facility.

(5) Ensuring desalinated water meets state water quality standards.
(6) Impediments or constraints, other than water rights, to increasing the use of desalinated water both in coastal and inland regions.
(7) The economic impact and potential impacts of the desalination industry on state revenues.
(8) The role that the state should play in furthering the use of desalination technology in California.
(9) An evaluation of a potential relationship between desalination technology and alternative energy sources, including photovoltaic energy and desalination.
(c) (1) The task force shall be convened by the department and be comprised of one representative from each of the following agencies:
(A) The department.
(B) The California Coastal Commission.
(C) The State Energy Resources Conservation and Development Commission.
(D) The California Environmental Protection Agency.
(E) The State Department of Health Services.
(F) The Resources Agency.
(G) The State Water Resources Control Board.
(H) The CALFED Bay-Delta Program.
(I) The Department of Food and Agriculture.
(J) The University of California.
(K) The United States Department of Interior, if that agency wishes to participate.
(2) The task force shall also include, as determined by the department, one representative from a recognized environmental advocacy group, one representative from a consumer advocacy group, one representative of local agency health officers, one representative of a municipal water supply agency, one representative of urban water wholesalers, one representative from a regional water control board, one representative from a groundwater management entity, one representative of water districts, one representative from a nonprofit association of public and private members created to further the use of desalinated water, one representative of land development, and one representative of industrial interests.
(d) The sum of $600,000 is hereby appropriated from the Bosco-Keene Renewable Resources Investment Fund to the department for the purpose of establishing the task force and preparing the report required in subdivision (a).

-O-

Exhibit 51

California Coastal Commission

SEAWATER DESALINATION IN CALIFORNIA

October 1993

Acknowledgments:

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California Coastal Commission

Seawater Desalination in California

KEY DESALINATION FACTS

Technologies

- Reverse Osmosis.

Pressure is applied to the intake water, forcing the water molecules through a semipermeable membrane. The salt molecules do not pass through the membrane, and the water that passes through becomes potable product water.

- Distillation.

The intake water is heated to produce steam. The steam is then condensed to produce product water with low salt concentration.

Ranges in Plant Capacity (Other than offshore oil and gas platforms)

- 20 - 112,000 AF/yr.**[1]**

Costs

- Most seawater desalination plants in California would produce water in the range of $1,000 to $2,200 per acre-foot (1992 cost basis).

Energy Use

- 2,500 to 29,500 kilowatt hours per acre-foot (kWh/AF).

Recovery (Percent of product water per unit input flow.)

- For every 100 gallons of seawater input, 15 to 50 gallons of fresh water would be produced (a "recovery" of 15 to 50%). The remainder is waste brine solution containing dissolved solids.

Water Quality

- 1.0 to 500 ppm tds.**[2]**

Feedwater Source

- Desalination plants can use either a pipeline into the ocean or wells on the beach or seafloor for intake of seawater.

Plant Size

- Area:

Varies according to plant design. Proposed or existing desalination plants in California range from 80 square feet for a 16 AF/yr plant to 7.5 acres for a 5,000 AF/yr plant.**[3]**

- Height:

15 to 20 feet for typical reverse osmosis equipment. 30 to 45 feet for typical distillation equipment.

Potential Coastal Zone Impacts

- Air quality
- Commercial and recreational fishing
- Construction impacts on land and marine species and habitats
- Energy use
- Growth-inducing effects
- Marine resources impacts from feedwater intake and ocean discharge
- Navigation
- Noise
- Potential hazardous releases from accidents
- Public access
- Recreation
- Visual quality
- Water quality
- Water quantity (e.g., effects of drawdown or saltwater intrusion of groundwater wells)
- Cumulative impacts

Saudi Arabia Desal Plant PICTURE (missing)

ENDNOTES

1. One acre-foot (AF) equals approximately 326,000 gallons; this is equivalent to the amount of water that two to three households would consume in one year. Units of capacity are acre-feet per year (AF/yr), gallons per day (gpd) or million gallons per day (MGD). In most cases, conversions can not be made directly from gpd or MGD to AF/yr since most plants will not operate every day of the year.
2. The California secondary drinking water standard for maximum total dissolved solids (tds) concentration is 500 milligrams per liter (mg/L), which is equivalent to 500 parts per million (ppm). In contrast, the tds concentration in "typical seawater" is 34,420 mg/L (Source: CH2M Hill, "Preliminary Feasibility Study Report of Seawater Desalination Options for Goleta Water District," September 1989.)
3. For example, the City of Santa Barbara's plant is designed to accommodate a capacity of up to 10,000 AF/yr on 2.1 acres of land, including both the main pump station and the chemical treatment area.

Return to **Synopsis & Purpose**

Go to first chapter, **Chapter 1: Background**

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Seawater Desalination In California

SYNOPSIS & PURPOSE

With population growth and the recent six-year drought contributing to an increase in Californians' concerns about water scarcity, several communities and industries in California have proposed constructing desalination plants to convert saline water (e.g., seawater, brackish water or treated wastewater) into fresh water. Because all or portions of seawater desalination plants will be located in the coastal zone, the facilities will come under California Coastal Act requirements.

This report provides background technical and policy information on desalination. The document was reviewed by the California Coastal Commission but has not been adopted as a policy document. The Commission's Energy and Ocean Resources and Technical Services Division staff has prepared this report to provide the Coastal Commission, local governments, state and federal agency staffs, and the public with the following information:

- A brief description of desalination technologies;
- The status of seawater desalination in California;
- Coastal Act issues that pertain to the siting and construction of desalination plants in the coastal zone;
  - a) The permitting process for desalination plants
  - b) A listing of other agencies with regulatory authority over desalination;
  - c) Legislative issues related to desalination plants;
- Recommendations.

Coastal Desalination Plants Map

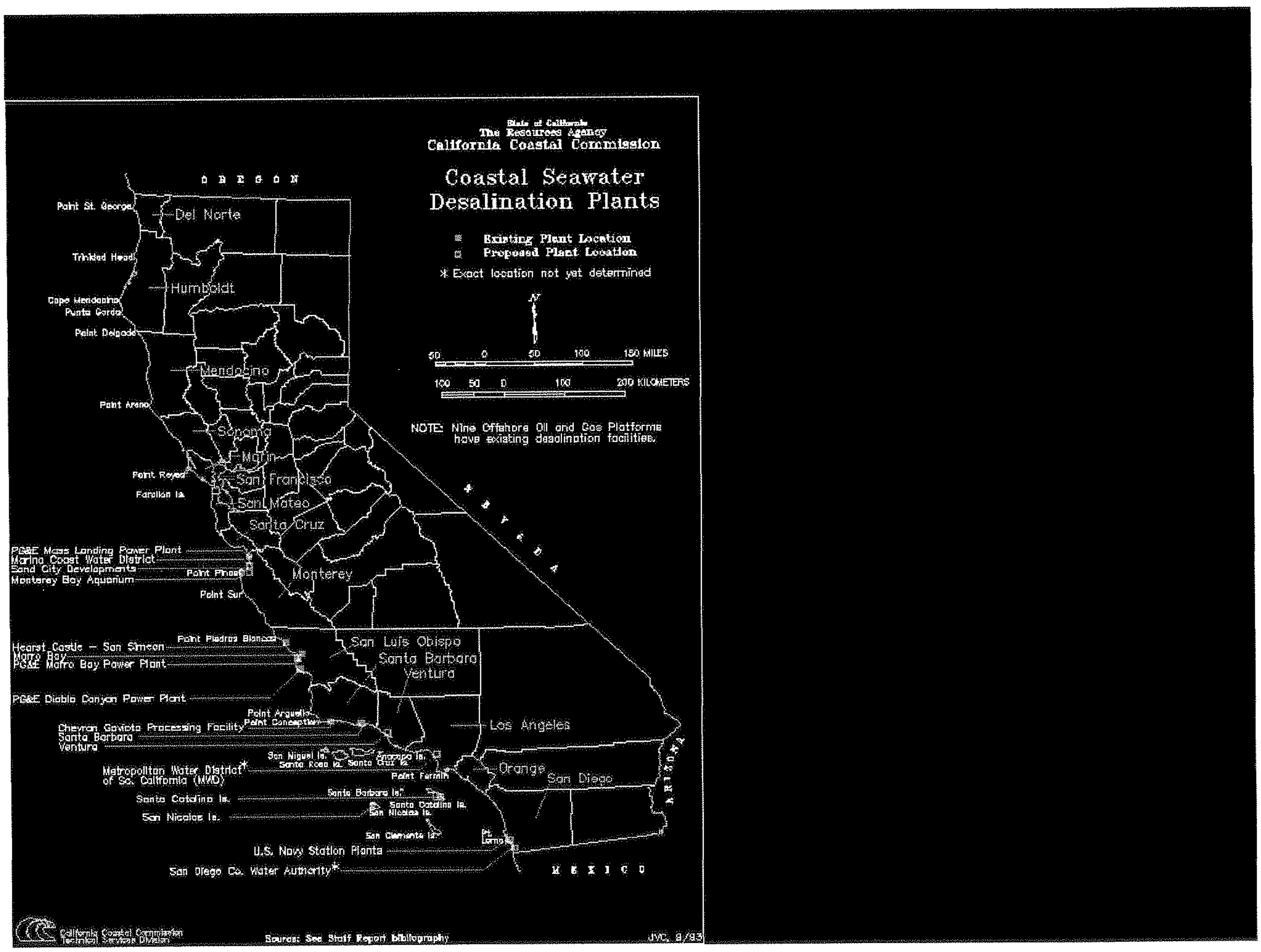

Table 1. Coastal Seawater Desalination Plants in California

Plant*	Purpose	Technology	Capacity**	Energy Use (kWh/AF)	Feedwater Source	Size**
Existing Plants						
Chevron Gaviota Oil and Gas Processing Plant	Processing plant	Reverse osmosis (RO)	460 AF/yr	15,000	Ocean	1,170 sq. ft.
City of Morro Bay ***	Domestic	RO	600,000 gpd	8,900	Seawater wells	9,000 sq. ft.
City of Santa Barbara ***	Domestic	RO	7,500 AF/yr	6,600	Ocean	2.1 acres
DPR, Hearst San Simeon State Historical Monument ***	Visitor Center Uses	RO	40,000 gpd	Data not available (n.d.)	Ocean	n.d.
Monterey Bay Aquarium ****	Aquarium	RO	43,000 gpd	n.d.	Ocean	n.d.
SCE, Santa Catalina Island	Domestic	RO	132,000 gpd	n.d.	Seawater wells	2,100 sq. ft.
Offshore oil and gas platforms	Platform Uses	Both	2,000 to 34,000 gpd	n.d.	Ocean	n.d.
PG&E Diablo Canyon Power Plant	Power plant	RO	576,000 gpd	9,100	Ocean	1 acre
PG&E Morro Bay Power Plant	Power plant	Distillation	430,000 gpd	n.d.	Ocean	n.d.
PG&E Moss Landing Power Plant	Power plant	Distillation	475,000 gpd	n.d.	Ocean	n.d.
U.S. Navy, San Nicolas Island	Domestic	RO	24,000 gpd	n.d.	Seawater wells	160 sq. ft.
Proposed Projects						
Sand City, Proposed Sterling Hotel/Conference Center *****	Private Development	RO	20 AF/yr	n.d.	Seawater wells	n.d.
Cambria Community Services District	Domestic	RO	1 MGD	n.d.	Groundwater wells or Ocean	n.d.
City of Buenaventura	Domestic	RO (probable)	5 to 7 MGD	n.d.	Seawater wells or Ocean	n.d.
Marina Coast Water District	Domestic	RO	1 to 3.5 MGD	n.d.	Seawater wells	n.d.
Metropolitan Water District of Southern California	Domestic	Distillation	5 MGD	6,000	Ocean	n.d.
San Diego County Water Authority	Domestic	RO	10 to 30 MGD	7,200	Ocean	2 acres
U.S. Navy, N. Island Naval Air Stn. & 32nd St. Naval Stn., San Diego	Power plant	RO	700,000 gpd total	n.d.	Seawater wells	n.d.

Excerpts from Chapter 2, pp. 15-26
CRO/RB, 9/93

Notes:

* Shaded projects have been all or in part approved or conditionally approved by the California Coastal Commission.

** 1 acre = 43,560 sq. ft. 1 acre-foot (AF) = 325,851 gallons. In most cases, gallons per day (gpd)/millions of gallons per day (MGD) can not be converted to acre-feet per year (AF/yr) since most plants do not operate every day of the year.

*** Plant is permitted and constructed but is not operating.

**** Plant is permitted and is under construction.

***** Plant was permitted but has not been constructed.

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Seawater Desalination in California

CHAPTER ONE: *BACKGROUND*

Desalination Plants Worldwide

Of the more than 7,500 desalination plants in operation worldwide, 60% are located in the Middle East. The world's largest plant in Saudi Arabia produces 128 MGD of desalted water. In contrast, 12% of the world's capacity is produced in the Americas, with most of the plants located in the Caribbean and Florida. To date, only a limited number of desalination plants have been built along the California coast, primarily because the cost of desalination is generally higher than the costs of other water supply alternatives available in California (e.g., water transfers and groundwater pumping). However, as drought conditions occur and concern over water availability increases, desalination projects are being proposed at numerous locations in the state.

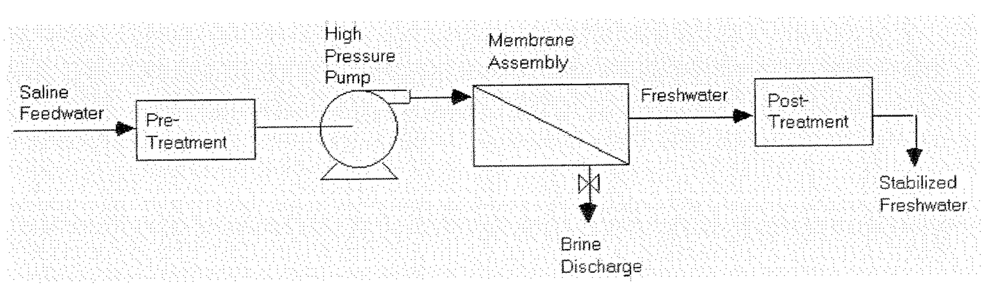
Desalination Technologies

Desalination is a process that removes dissolved minerals (including but not limited to salt) from seawater, brackish water, or treated wastewater. A number of technologies have been developed for desalination, including reverse osmosis (RO), distillation, electrodialysis, and vacuum freezing. Two of these technologies, RO and distillation, are being considered by municipalities, water districts, and private companies for development of seawater desalination in California. These methods are described below.

- **Reverse Osmosis (RO)**

In RO, feedwater is pumped at high pressure through permeable membranes, separating salts from the water (Figure 1). The feedwater is pretreated to remove particles that would clog the membranes. The quality of the water produced depends on the pressure, the concentration of salts in the feedwater, and the salt permeation constant of the membranes. Product water quality can be improved by adding a second pass of membranes, whereby product water from the first pass is fed to the second pass.

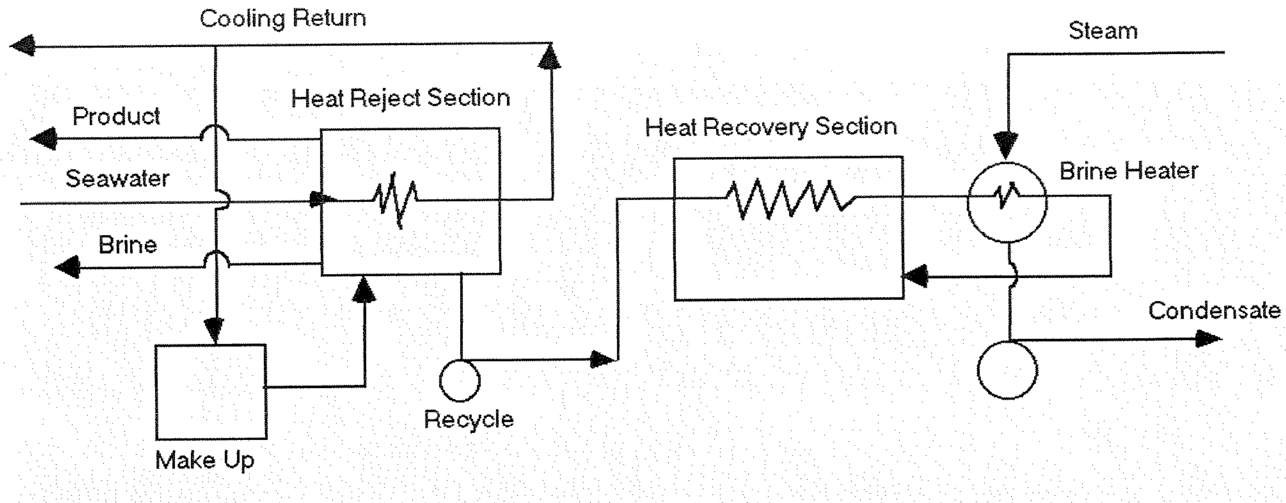
Figure 1. Flow Diagram of a reverse osmosis system (courtesy of USAID). (Kahn, 1986.)



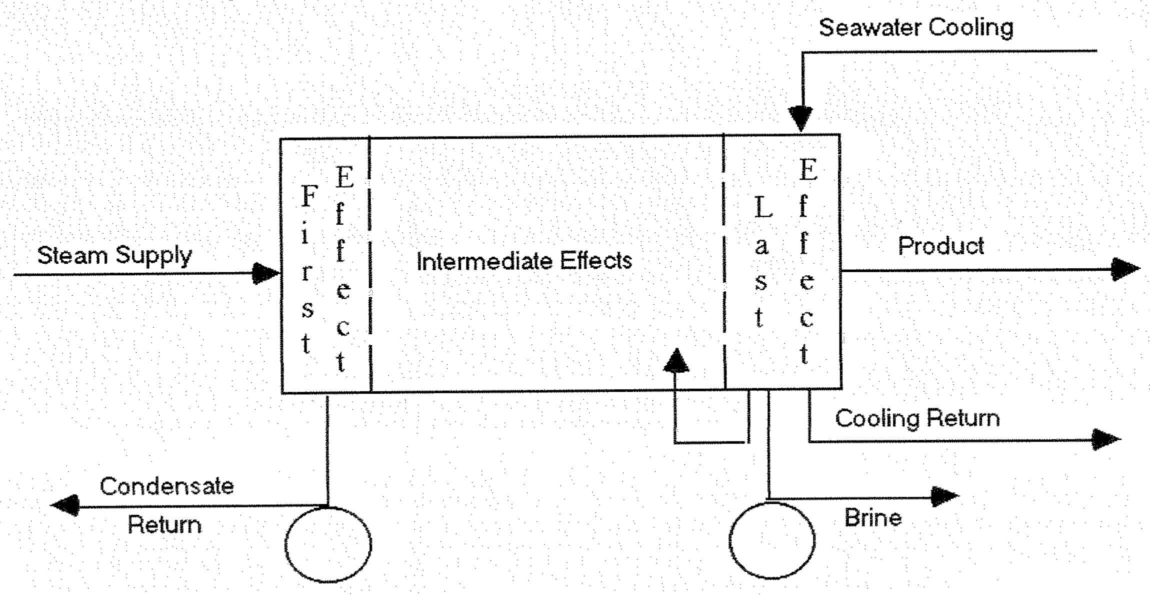
- **Distillation**

In the distillation process, feedwater is heated and then evaporated to separate out dissolved minerals. The most common methods of distillation include multistage flash (MSF), multiple effect distillation (MED), and vapor compression (VC) (Figure 2).

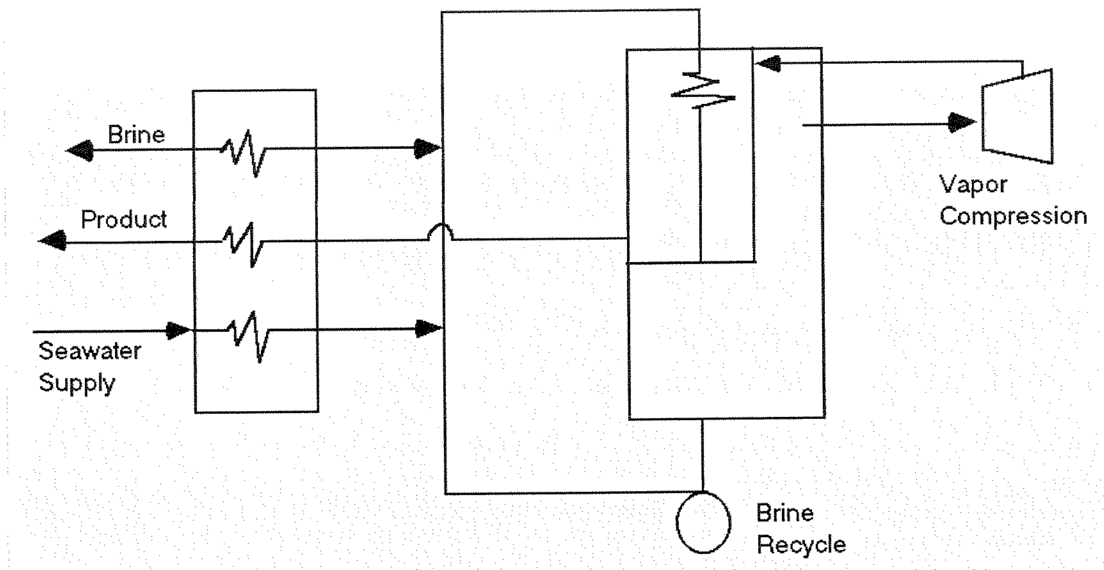
Figure 2. Common methods of distillation.



Multi-State Flash (Recycle)



Multiple Effect



Vapor Compression

In MSF, the feedwater is heated and the pressure is lowered, so the water "flashes" into steam. This process constitutes one stage of a number of stages in series, each of which is at a lower pressure. In MED, the feedwater passes through a number of evaporators in series. Vapor from one series is subsequently used to evaporate water in the next series. The VC process involves evaporating the feedwater, compressing the vapor, then using the heated compressed vapor as a heat source to evaporate additional feedwater. Some distillation plants are a hybrid of more than one desalination technologies. The waste product from these processes is a solution with high salt concentration.

Input Water (Feedwater)

Desalination plants may use seawater (directly from the ocean through offshore intakes and pipelines, or from wells located on the beach or seafloor), brackish groundwater, or reclaimed water as feedwater. Since brackish water has a lower salt concentration, the cost of desalting brackish water is generally less than the cost of desalting seawater. Intake pipes for desalination plants should be located away from sewage treatment plant outfalls to prevent intake of discharged effluent. If sewage treatment discharges or other types of pollutants are included in the intake, however, the pre- and post-treatment processes should remove the pollutants.

Product Water

Distillation plants produce a high-quality product water that ranges from 1.0 to 50 ppm tds, while RO plants produce a product water that ranges from 10 to 500 ppm tds. (The recommended California drinking water standard for maximum tds is 500 mg/L, which is equivalent to 500 ppm.) In desalination plants that produce water for domestic use, post-treatment processes are often employed to ensure that product water meets the health standards for drinking water as well as recommended aesthetic and anti-corrosive standards.

Desalination product water may be used in its pure form (e.g., for make-up water in power plant boilers) or it may be mixed with less pure water and used for drinking water, irrigation, or other uses. The desalinated product water is usually more pure than drinking water standards, so when product water is intended for municipal use, it may be mixed with water that contains higher levels of total dissolved solids. Pure desalination water is highly acidic and is thus corrosive to pipes, so it has to be mixed with other sources of water that are piped onsite or else adjusted for pH, hardness, and alkalinity before being piped offsite.

Product Water Recovery

The product water recovery relative to input water flow is 15 to 50% for most seawater desalination plants. For every 100 gallons of seawater, 15 to 50 gallons of pure water would be produced along with brine water containing dissolved solids. A desalination plant's recovery varies, in part because the particulars of plant operations depend on site-specific conditions. In several locations in California, pilot projects are being proposed to test plant operations before full-scale projects are built.

Pretreatment Processes

Pretreatment processes are needed to remove substances that would interfere with the desalting process. Algae and bacteria can grow in both RO and distillation plants, so a biocide (usually less than 1 mg/L chlorine) is required to clean the system. Some RO membranes cannot tolerate chlorine, so dechlorination techniques are required. Ozone or ultraviolet light may also be used to remove marine organisms. If ozone is used, it must be removed with chemicals before reaching the membranes. An RO technology has been developed recently that does not require chemical pretreatment.

In RO plants, suspended solids and other particles in the feedwater must be removed to reduce fouling of the membranes. Suspended solids are removed with coagulation and filtration. Metals in the feedwater are rejected along with the salts by the membranes and are discharged in the brine. With normal concentrations for metals in seawater, the metals present in the brine discharge, though concentrated by the RO process, would not exceed discharge limits. Some distillation plants may also need to remove metals due to potential corrosion problems.

Filter Backwashing, Membrane Cleaning and Storage, Scaling Prevention and Removal, and Pipeline Cleaning

The filters for pretreatment of feedwater at RO plants must be cleaned every few days (backwashed) to clear accumulated sand and solids. The RO membranes must be cleaned approximately four times a year and must be replaced every three to five years. Alkaline cleaners are used to remove organic fouling, and acid cleaners are used to remove scale and other inorganic precipitates. All or a portion of RO plants must be shut down when the membranes are replaced. When RO plants are not used continuously, the RO membranes must be stored in a chemical disinfection/preservation solution that must be disposed of after use. Distillation plants can also be shut down for tube bundle replacement, which is analogous to membrane replacement.

Desalination plant components must be cleaned to reduce scaling-a condition where salts deposit on plant surfaces, such as pipes, tubing or membranes. Scaling is caused by the high salt concentration of seawater and can result in reduced plant efficiency and corrosion of the pipes. In general, scaling increases as temperature increases; thus scaling is of greater concern for distillation plants, since RO plants require lower temperatures to operate. Scaling can be reduced by introducing additives to inhibit crystal growth, reducing temperature and/or salt concentrations, removing scale-forming constituents, or seeding to form particles. Once scales have formed, they can be removed with chemical or mechanical means.

In addition to scaling, both RO and distillation plant intake and outfall structures and pipelines can become fouled with naturally occurring organisms or corroded. Structures and pipelines may be cleaned by mechanical means or by applying chemicals or heat. Feedwater may also be deaerated to reduce corrosion.

Waste Discharges

Desalination plants produce liquid wastes that may contain all or some of the following constituents: high salt concentrations, chemicals used during defouling of plant equipment and pretreatment, and toxic metals (which are most likely to be present if the discharge water was in contact with metallic materials used in construction of the plant facilities). Liquid wastes may be discharged directly into the ocean, combined with other discharges (e.g., power plant cooling water or sewage treatment plant effluent) before ocean discharge, discharged into a sewer for treatment in a sewage treatment plant, or dried out and disposed of in a landfill. Desalination plants also produce a small amount of solid waste (e.g., spent pretreatment filters and solid particles that are filtered out in the pretreatment process).

For example, the capacity of the City of Santa Barbara's desalination plant is 7,500 AF/yr (about 7.16 MGD). In May 1992, the plant produced 6.7 MGD of product water and generated 8.2 MGD of waste brine with a salinity approximately 1.8 times that of seawater. An additional 1.7 MGD of brine was generated from filter backwash. Assuming that concentrations of suspended solids in the seawater feed range from 10 to 50 ppm, approximately 1.7 to 5.1 cubic yards per day of solids were generated, which is equivalent to one to two truck-loads per week. (Source: Woodward-Clyde Consultants, EIR for the City of Santa Barbara and Ionics, Inc.'s Temporary Emergency Desalination Project, March 1991.)

Energy Use

The energy used in the desalination process is primarily electricity and heat. Energy requirements for desalination plants depend on the salinity and temperature of the feedwater, the quality of the water produced, and the desalting technology used. Estimates for electricity use requirements for various technologies for seawater desalination are:

Multistage Flash (MSF)	3,500 — 7,000 kWh/AF
Multiple Effect Distillation (MED)	2,500 — 5,000 kWh/AF
Vapor Compression (VC)	10,000 — 15,000 kWh/AF
Reverse Osmosis (RO) — single pass	5,800 — 11,000 kWh/AF
Reverse Osmosis (RO) — double pass	6,500 — 12,000 kWh/AF

(Source: Wilf, 1991.)

In addition to electricity requirements, MSF, MED, and some VC plants also use thermal energy to heat feedwater. (Because of the inefficiency of converting thermal energy to electricity, there is a high energy "penalty" if electricity is used to heat feedwater.) For example, in addition to the 3,500 to 7,000 kWh/AF of energy required for electricity, the thermal energy needs for a MSF distillation plant is estimated at 270 million Btu/AF (about 26,000 kWh/AF); for MED plants, the estimated additional thermal energy requirements are 230 million Btu/AF (about 22,000 kWh/AF).**[1]** Consequently, the total energy needs for distillation technologies are higher than for RO technologies.

Energy use requirements for desalination plants are high. For example, an estimated 50 million kWh/yr would be required for full-time operation of the City of Santa Barbara's desalination plant to produce 7,500 AF/yr of water. In contrast, the energy needed to pump 7,500 AF/yr of water from the Colorado River Aqueduct or the State Water Project to the Metropolitan Water District (MWD) of Southern California is 15 to 26 million kWh/yr. These energy requirements may be compared to the energy use of a small- to medium-sized industrial facility (such as a large refinery, small steel mill, or large computer center) which uses 75,000 to 100,000 kWh/yr.

Both RO and distillation plants can benefit from cogeneration plants to reduce energy use. Since increased energy use may cause adverse environmental impacts, the individual and cumulative impacts of energy use and production at a proposed desalination plant will require case-by-case analysis.

Comparison of Distillation and Reverse Osmosis Technologies

One advantage of distillation plants is that there is a greater potential for economies of scale. Distillation plants also do not shut down a portion of their operations for cleaning or replacement of equipment as often as RO plants, although distillation plants can and have shut down for tube bundle replacement and cleaning. Pretreatment requirements are greater for RO plants, because coagulants are needed to settle out particles before water passes through the membranes. Unlike RO plants, distillation plants do not generate waste from backwash of pretreatment filters.

Advantages of RO plants over distillation include: RO plant feedwater generally does not require heating, so the thermal impacts of discharges are lower; RO plants have fewer problems with corrosion; RO plants usually have lower energy requirements; RO plants tend to have higher recovery rates-about 45% for seawater; the RO process can remove unwanted contaminants, such as trihalomethane-precursors, pesticides, and bacteria; and RO plants take up less surface area than distillation plants for the same amount of water production.

Costs of Desalinated Water

The cost to produce water from desalination depends on the technology used and the plant capacity, among other factors. For example, the cost of desalted water in Santa Barbara ($1,900/AF) results from the following: a write-off of the capital cost over a short five-year period, high financing costs, and high energy costs. The overall costs of water production are about the same for RO and some forms of distillation plants.

Price estimates of water produced by desalination plants in California range from $1,000 to $4,000/AF. Table 2 lists the estimated costs of producing water for existing and proposed plants, where the information is available. (Specific cost estimates for most existing and proposed California desalination plants are also included in Chapter 2 of this report.) The costs include capital and operating and maintenance costs. For long-term projects, capital costs would most likely be amortized over an assumed plant life of 20 to 30 years. Capital costs for RO plants tend to be lower than for distillation plants. Some of the proposals are for plants that would operate for only a few years. Operating a plant on a part-time, rather than full-time, basis may be more expensive in the long run because maintenance and capital costs must be paid while the plant is shut down.

Table 2. Costs of Water from Desalination Plants & Other Sources (1992 Cost Basis)

	$ Cost (per AF)
SEAWATER DESALINATION PLANTS	
▪ Chevron Gaviota Oil and Gas Processing Plant	4,000
▪ City of Morro Bay	1,750
▪ City of Santa Barbara**	1,900
▪ Marin Municipal Water District*	1,600 – 1,700
▪ Metropolitan Water District (MWD) of Southern California*	700
▪ Monterey Bay Aquarium*	1,800
▪ PG&E Diablo Canyon Power Plant	2,000
▪ San Diego County Water Authority (South Bay Desalination Plant)*	1,100 – 1,300
▪ SCE, Santa Catalina Island	2,000
▪ U.S. Navy, San Nicolas Island	6,000

OTHER WATER SOURCES	
▪ City of Santa Barbara	
Lake Cachuma — existing source	35
Groundwater — existing	200
Groundwater wells in mountains — new source	600 – 700
Expanding reservoir — new	950
Tying into State Water Project	1,300
Temporary State Water Project deliveries via MWD	2,300
▪ Metropolitan Water District (MWD) of Southern California	
Colorado River — existing	27
California Water Project — existing	195
Imperial Irrigation District — new	130
Water storage project — new (no water now)	90
▪ San Diego County	
MWD — existing	270
New water projects — new	600 –700

Notes:

* Cost estimate for a proposed plant.

** Cost amortized over 5 years.

Unless otherwise noted, cost estimates for desalination plants are costs to produce the water. Cost estimates listed under other sources are the costs to the city, county, or water district.

Costs of Other Water Sources

A number of California coastal communities are facing water shortages. Although the communities may have relatively inexpensive existing supplies of water, the supplies are perceived as being insufficient to meet community needs. New water supplies are more expensive than existing supplies, and in some cases the prices are comparable to desalinated water. Table 2 summarizes the costs of various water supplies.

In 1991, the Metropolitan Water District (MWD) of Southern California paid $27/AF for water from the Colorado River and $195/AF for water from the California Water Project. New sources of water would have cost $128/AF from the Imperial Irrigation District and $93/AF from Arvin Edison Water Storage in Kern County (if water was available during the drought). (Source: pers. comm. with Bob Muir, MWD, 1991.)

Noninterruptible untreated water for domestic uses in San Diego is purchased from the MWD for $269/AF; treated water costs an additional $53/AF. The least expensive new supplies, other than desalination, would cost $600-$700/AF. (Sources: pers. comm. with Gordon Hess, SDCWA, 1991 and Robert Yamada, SDCWA, 1992.)

In Santa Barbara, untreated water from the Cachuma reservoir costs $35/AF. Development of new wells to use further the City's groundwater basins would cost $200/AF, while new groundwater wells in the mountains would cost approximately $600-700/AF. Enlarging Cachuma Reservoir, if feasible, is estimated to cost $950/AF. During the recent drought, the City purchased water from the State Water Project on a temporary, emergency basis at a cost of $2,300/AF. This water was made available through a series of exchange arrangements with water agencies between Santa Barbara and the MWD. Permanently tying into the State Water Project is estimated to cost $1,300/AF. (Source: pers. comm. with Dale Brown, City of Santa Barbara, 1992.)

ENDNOTES

1. British thermal unit (Btu) values are multiplied by 0.33 to compute a kWh-equivalent because the efficiency of conversion from thermal energy to electricity is about 33%.

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Seawater Desalination in California

CHAPTER TWO: *COASTAL DESALINATION PROJECTS IN CALIFORNIA*

- **Projects Approved/Conditionally Approved by Coastal Commission**
  - Chevron Gaviota Oil and Gas Processing Plant
  - City of Morro Bay
  - City of Santa Barbara
  - Department of Parks & Recreation, Hearst San Simeon State Historical Monument
  - Monterey Bay Aquarium
  - Proposed Hotel/Conference Sterling Center, Sand City
  - SCE, Santa Catalina Island
  - Offshore Oil and Gas Platforms
- **Existing Coastal Desalination Projects Not Reviewed by Commission**
  - PG&E Diablo Canyon Power Plant
  - PG&E Morro Bay Power Plant
  - PG&E Moss Landing Power Plant
  - U.S. Navy, San Nicolas Island
- **Status of Other Proposed Coastal Desalination Plants**
  - Alameda County Water District
  - Cambria Community Service District
  - Channel Islands Beach Community Services District
  - City of Buenaventura
  - City of Fort Bragg
  - City of Goleta
  - City of Lompoc
  - City of San Luis Obispo
  - Los Angeles Department of Water and Power
  - Marin Municipal Water District
  - Marina Coast Water District
  - Mendocino County property owners
  - Metropolitan Water District of Southern California
  - Monterey Peninsula Water Management District
  - North Coast County Water District
  - Orange County Water District
  - Sands of Monterey development, Sand City
  - San Diego County Water Authority
  - U.S. Navy, North Island Naval Air Station & 32nd Street Naval Station, San Diego

Projects Approved/Conditionally Approved by Coastal Commission

- **Chevron Gaviota Oil and Gas Processing Plant**

The desalination unit at the Gaviota Oil and Gas Processing Plant began operation in 1987 and has design specifications to last 25 years. The RO unit, which has the capacity to produce 460 AF/yr (about 450,000 gpd) of water, uses power from an onsite cogeneration plant to produce 100% of the processing plant's current freshwater needs (about 153,000 gpd). Several grades of water are produced, with the least pure at about 500 ppm tds and the most pure at about 50 ppm tds. A portion of product water is subsequently treated by ion exchange to less than 1 ppm tds for use as boiler feed water. Product recovery is about 35%. Energy use is approximately 15,000 kWh/AF. The unit occupies an area of about 90 feet by 130 feet, and the tallest component is about 15 feet high. The average cost to produce the water is about $4,000/AF. This cost is relatively high for the following reasons: the unit is small, so there are not economies of scale; the unit does not use energy recovery; a new and expensive seawater intake system was built; and Chevron constructed the unit to meet the same specifications with respect to quality of construction and safety as the rest of the processing plant. (Source: pers. comm. with Bob Burelson, Chevron, 1991, 1993.)

The Environmental Impact Report/Statement (EIR/S) prepared for the project found that the impacts of desalination discharges would not be significant as long the conditions in Chevron's NPDES permit issued by the State RWQCB were followed. Chevron originally discharged waste brine directly to the ocean through an outfall terminating in the surf zone at a water depth of 10-15 feet. In May 1993, Chevron began discharging combined effluent from the processing plant (treated produced water) and the RO unit (brine) through a 5,200-foot-long produced water outfall at a 100 foot water depth. The combined discharge is authorized under a modified RWQCB NPDES permit.

In April 1985, the Coastal Commission granted a coastal development permit (CDP) to Chevron for construction of two pipelines and one produced water outfall for the oil and gas processing plant *(No. E-85-2)*. In July 1986, the Coastal Commission approved with conditions an amendment to this CDP to allow for the addition of the offshore portions of the desalination unit-two seawater intake lines and one brine discharge line *(No. E-85-2-A)*. The conditions imposed in the amendment were: 1) the conditions of CDP No. E-85-2 will remain in effect; 2) Chevron will obtain a NPDES permit from the RWQCB for the discharges; and 3) the development will not interfere with rights of access.

- **City of Morro Bay**

The City of Morro Bay has constructed a temporary emergency RO desalination plant that is not currently in operation. Product water from the 0.6 MGD plant would replace a portion of the City's water supply as needed due to reduced quantity and/or quality of the City's groundwater supplies. The City was able to build the plant without prior preparation of an EIR by existence of a state of emergency because of drought. In April 1993, the Morro Bay City Council certified a project EIR that includes analysis of continuous operation of a 1.2 MGD plant to provide a permanent supplemental water supply. When operating, the plant draws feedwater from six seawater intake wells. The plant may also use brackish water on the Morro Creek aquifer as an alternative source of feedwater. Product recovery is about 40% for seawater and 65% for brackish water. Electricity use for the plant is about 8,900 kWh/AF for seawater. The product water would cost the city $1,750/AF based upon a seawater source. (Source: pers. comm. with Bill Boucher, City of Morro Bay, 1991, 1993.)

In January 1991, the Coastal Commission granted the City a permit waiver *(No. 4-90-55-DM)* for the drilling of test wells to determine desalination source water quality. In June 1991, the City approved an Emergency CDP for the portion of the desalination plant within the City's permit jurisdiction. In September 1991, the Commission approved with conditions a CDP *(No. 4-91-37)* for the portions of the plant within the Commission's original permit jurisdiction; this CDP authorized the discharge of brine through the Morro Bay/Cayucos Wastewater Treatment Facility outfall. In January 1992, one month after the U.S. Environmental Protection Agency objected to the use of the municipal outfall for brine disposal purposes, the Commission revoked CDP No. 4-91-37 at the request of the Cayucos Sanitary District. In February 1992, the City approved a CDP for a revised project that provided for the discharge of brine through the PG&E Morro Bay Power Plant cooling water outfall. The Commission granted a CDP *(No. 4-92-01)* for the revised project in April 1992 and adopted revised findings in June 1992. CDP No. 4-92-01 contains the following thirteen special conditions:

1) the permit shall apply only during a period of Level 5 Water Emergency conditions as declared by the City Council in the City of Morro Bay;

2) the permit shall be limited to eighteen months from the date of approval (at the end of this period, a regular CDP for continued operation would be needed to retain the plant);

3) acceptance of the permit shall result in no net increase to the City's existing yearly water supply (desalination product water shall be used only to replace water that is unavailable to the City because of decreases in water supplies due to quantity or quality standards sufficient to create a Level 5 "Emergency Water Supply Condition");

4) the City shall not discharge any seawater brine or brackish wastewater through the Morro Bay/Cayucus Wastewater Treatment Facility or discharge outfall;

5) during operation, the City shall submit monthly reports to the Executive Director (E.D.) on the effects of seawater intake on the City's aquifer and groundwater wells;

6) the City shall submit to the E.D. a final agreement between the City and PG&E to allow the City to use PG&E's outfall and easement area for desalination plant discharges;

7) the City shall discharge all desalination brine and wastes through the PG&E outfall;

8) the City shall submit to the E.D. any marine quality/biological monitoring studies and/or other data required by the RWQCB as conditions of its NPDES permit;

9) specified mitigation measures shall be employed to minimize impacts to the sand dune plant community from installation of the seawater feed and brine discharge pipelines;

10) specified mitigation measures shall be employed to minimize alteration of Morro Creek habitat from installation of the seawater feed and brine discharge pipelines;

11) the City shall submit for review and approval by the E.D. a landscape and irrigation plan;

12) the City shall submit for review and approval by the E.D. a construction schedule, traffic and public access plan/defined construction staging area that minimizes disruption to public accessways and that provides for continued recreational use of these areas; and

13) the City shall process and approve an interim CDP for the desalination plant and lines within the City's jurisdiction that is consistent with CDP No. 4-92-01.

As specified in Special Condition 1, the City's desalination plant is not operating at this time, since a Level 5 Emergency Water Supply Condition is not currently in effect.

- **City of Santa Barbara**

In March 1992, the City of Santa Barbara began operation of a temporary seawater RO desalination plant. After operating for several months to allow testing of components, the plant was placed on long-term standby status due to the increased availability of reservoir supplies (which were replenished during the Winter 1992/93 rains) and reduced demand from water customers. The plant, which has a capacity of 7,500 AF/yr, is capable of providing 21% of the average pre-drought water needs of the City of Santa Barbara, Goleta, and Montecito. The cost of the water to the City is projected to be $1,918/AF. Under the City's contract for the plant, capital costs must be paid for in five years. If the plant continues to operate beyond that time, the cost of the water will be reduced.

The plant is located on 2.1 acres (including pump station and chemical treatment area) in an urban area of Santa Barbara. Product water quality is projected to be between 284 and 400 ppm tds (the operational value during plant testing was approximately 300 ppm tds). Product water recovery is 45%. Electricity use for the plant is about 6,600 kWh/AF. The desalination plant was designed to take feedwater from two existing ocean intakes and to discharge brine through an existing outfall. Intake velocity is 3 cm/s or less (local ocean currents flow at a rate of 0-40 cm/s), and the intake screen has 3/8-inch spacing, thus excluding most marine species (although small invertebrates and larval and other microscopic organisms can still be entrained). The plant will discharge about 10 MGD waste brine and backwash that will be mixed with effluent from the El Estero Wastewater Treatment Plant. The combined discharge will have a salinity level of 26,000 to 55,000 ppm. The plant will generate 1.7 to 5.1 cubic yards/day of nonhazardous solid waste. (Source: pers. comm. with Dale Brown, City of Santa Barbara, 1991, 1993.)

In March 1991, the City's Planning Commission approved a CDP for the onshore portion of the temporary desalination plant. In May 1991, the Coastal Commission approved with conditions a CDP *(No. 4-91-18)* for installation of a liner sleeve in an existing abandoned ocean outfall line and addition of ocean intake structures and auxiliary facilities to service a temporary five-year facility with a production capacity of 10,000 AF/yr. CDP No. 4-91-18 contains the following six special conditions:

1) the permit will apply for a period of five years only;

2 the applicant shall submit to the Executive Director for review and approval a pre-construction baseline monitoring program and an ongoing monitoring program, and if monitoring results indicate any adverse effects on the marine environment, the applicant must apply to the RWQCB for an amendment to the NPDES permit;

3 the applicant must obtain an NPDES permit prior to operation;

4) the applicant shall submit a plan for reducing impacts of construction on recreation and public access prior to operation, shall enclose the beach excavation area within a fence for public safety, and shall locate the excavation area to minimize disruption of lateral beach access;

5) the applicant shall mark the subsurface intake structures with a U.S. Coast Guard-approved lighted navigational buoy and shall notice the project in the "Notice to Mariners"; and

6) the applicant shall submit to the Executive Director for review and approval a plan for monitoring, evaluating and mitigating impacts to archaeological resources.

In June 1991, the citizens of the City of Santa Barbara voted for development of a permanent desalination facility. To extend the life of the project beyond the five-year limit of CDP No. 4-91-18, the City will have to complete additional environmental review and permitting and receive another Coastal Commission permit. The additional environmental review is currently underway.

- **Department of Parks & Recreation, Hearst San Simeon State Historical Monument**

The California Department of Parks and Recreation (DPR), San Simeon Region has installed, but is not currently operating, an RO plant at the Hearst San Simeon State Historical Monument visitor center. The unit would provide sufficient water supplies for onsite uses during the summer months and would replace the former practice of trucking-in water during the summer. The capacity of the unit is 40,000 gpd, but the plant would operate only 16 hours/day from May through September for a total output of about 26,000 gpd. The DPR is leasing the unit, which was renovated and transported to the site, from the State Department of Water Resources (DWR) for a ten-year period.

Seawater would be obtained from an intake pipe located 650 feet offshore. Product water recovery would range from 28-40%, depending on seawater temperature, operating pressure, and membrane condition. The product water would contain 200 to 400 ppm tds and the concentration of the brine discharge would range from 45,000 to 63,000 ppm tds. Discharges to the ocean would not contain chemical additives or treatment aids, as chemicals used during the desalination process would be treated and discharged into a sewer line or disposed of at a treatment facility. (Source: pers. comm. with David Donahue, DPR, 1991; Robert Kinney, DPR, 1993.)

In March 1991, the County of San Luis Obispo granted a permit for the onshore portion of the project. In May 1991, the Coastal Commission approved with conditions a CDP *(No. 4-90-40)* for installation of a submerged pump, 650 feet of intake line and 335 feet of discharge line for the desalination plant. CDP No. 4-90-40 contains the following two special conditions:

1) The permit is valid for two years from the date of Commission action. As a filing requirement for a new permit application for a desalination plant, the applicant shall submit a water management plant for both the Hearst San Simeon State Historical Monument and the San Simeon State Beach, identifying current water uses and identifying methods to reduce water consumption. The goal of this plan will be to reduce water consumption so as to reduce or eliminate the need to desalinate ocean water.

2) The pipelines crossing the beach shall remain covered at all times during the two-year process (by either sand or a wooden covering).

The DPR is in the process of applying to the Commission for a CDP amendment to allow for operation of the plant on a standby status (i.e., during drought conditions) beyond the two-year period authorized in Special Condition 1. The California Department of Fish and Game (DFG) determined that plant operations would not significantly impact fish or wildlife.

- **Monterey Bay Aquarium**

The Monterey Bay Aquarium has begun construction of an onsite RO unit to provide water for some of the aquarium's non-potable water needs (i.e., toilets), thus reducing the current demand for the City of Monterey's water. The desalination unit would have separate pipes and connections from the City's water supply and would have no provisions for trucked-in water if the unit breaks down. When completed, the unit will produce a maximum of 43,000 gpd with average production about 21,500 gpd. The unit would process water prefiltered by the existing seawater system that supplies the aquarium exhibit and research tanks. The quality of the water produced will be about 400 ppm tds. Although the water would be treated to potable water standards, it would not be classified as potable. Waste brine would be blended with seawater used in the aquarium and discharged through an existing outfall. The RWQCB determined that the desalination discharge would not require an NPDES permit based on the relatively small increase in flow rate (as proposed, the rate of discharge will increase from 15 gallons per minute (gpm) to about 51 gpm) and the insignificant amount of pollutants in the discharge. The cost to produce the water would be about $1,800/AF ($5.53/1,000 gals). (Source: pers. comm. with John Christensen, Monterey Bay Aquarium, 1991, 1993.)

In 1989, Monterey County wrote an ordinance that requires public ownership of desalination plants and requires that each plant have a dual system, where one side is held in reserve in case of a breakdown in the other side.**[1]** In January 1991, the county code was amended to allow for privately run desalination plants, as long as product water is used only onsite. The amendment was written to allow for the Monterey Bay Aquarium project and a privately run inland plant. In May 1991, the Monterey County Department of Health issued a permit to construct the desalination facility. In February 1992, the Coastal Commission approved a CDP amendment *(No. 3-90-40-A2)* for the remodeling of the Aquarium, including installation of a desalination unit and a 25,000 gallon storage reservoir. The amendment contains one condition related to desalination. Special Condition 2 states: "In the event that the building remodel is complete before the desalination system is operating, prior to any hookup of new fixtures to the public water system the permittee shall submit to the Executive Director for review written authorization from the Monterey Peninsula Water Management District for service to the added fixtures."

- **Proposed Hotel/Conference Sterling Center, Sand City**

In 1985, Sand City approved the Sterling Center development. The approval was appealed to the Coastal Commission which, after finding that the approval raised a substantial issue with the City's certified Local Coastal Program (LCP), denied the project in April 1986. (The Commission found in part that the project's proposed water use demand exceeded its LCP water allocation for the site.) The City subsequently approved a scaled-down project. However, this approval was nullified by the Monterey County Superior Court which ruled that substantial changes had been made to the project that required the preparation and distribution for public review of a revised Supplemental EIR.

After complying with the Court's decision, Sand City approved a revised version of the scaled-down project in November 1990. This project also exceeded the LCP water use demand allocation. To mitigate this impact, the applicant proposed to construct an onsite RO desalination facility with a capacity of 20 AF/yr (about 20,000 gpd). Feedwater for the plant would be taken from a groundwater well. The City also required that the applicant build a pilot desalination plant and provide testing and monitoring of the plant's discharges by a phytoplankton biologist to insure that adverse impacts to marine life are not created. The new permit was also appealed to the Commission, which found substantial issue on the appeal in February 1991 *(Appeal No. A-3-SNC-90-127)*. In April 1991, the Commission approved the development with a condition requiring that the applicant submit prior to construction of the desalination facility any approvals necessary to permit operation in the Monterey Bay area, including a RWQCB-approved NPDES permit for discharges of desalination wastes. The desalination facility has not been constructed to date.

- **SCE, Santa Catalina Island**

Southern California Edison (SCE) and Whitehawk Catalina, Inc. completed construction of a 132,000 gpd RO plant on Santa Catalina Island in June 1991. The plant produces 25 to 30% of the Island's water supply, including the potable water supply for the Hamilton Cove condominium development. The desalination plant is located adjacent to SCE's Pebbly Beach Generating Station, and brine is discharged through the station's existing cooling water outfall. Feedwater is taken from two seawater wells. Product recovery is about 27%. The size of the plant is about 2,100 square feet. The cost of the water produced is about $2,000/AF ($6/1,000 gals). In September 1989, the Coastal Commission approved a CDP *(No. E-89-3)* for construction of the plant with one condition requiring that SCE and Whitehawk Catalina obtain an NPDES permit prior to plant operation.

- **Offshore Oil and Gas Platforms**

In addition to onshore desalination facilities, a number of oil and gas structures on the Outer Continental Shelf (OCS) have desalination units that produce water for onsite uses. For example, RO units are located on Platforms Habitat, Henry, Hillhouse, and Hondo; distillation units are located on Platforms Gail, Grace, Harvest, Hermosa, and Hidalgo, and on Exxon's Offshore Storage and Treatment (OS&T) vessel. **[2]** Each unit produces 12,000 to 17,000 gpd, except for the units on Hillhouse and Henry, which produce 2,000 to 2,900 gpd and the unit on Habitat which produces 5,000 gpd of potable water and 6,000 gpd of "demineralizer feedwater" (used for NOx abatement in the platform's gas turbine). Platforms Gail, Harvest, Hermosa, and Hidalgo have two units each. The RO units cost about $80,000, and the distillation units cost about $180,000. No desalination units are located on platforms in state waters; fresh water is supplied through pipelines from shore.

Existing Coastal Desalination Projects Not Reviewed by Coastal Commission

- A desalination facility was a part of the original design for the **Pacific Gas & Electric Company (PG&E) Diablo Canyon Power Plant**. PG&E received a license for the power plant in 1968, so the desalination portion of the plant (which began operation in 1985) was not reviewed by the Coastal Commission. The desalination plant was originally a joint project by the State Department of Water Resources and the U.S. Department of the Interior, Office of Saline Water (which no longer exists). In 1992, PG&E began operating a new RO unit with a capacity of 576,000 gpd (about 600 AF/yr). Product recovery is approximately 45%. Electricity use is about 9,100 kWh/AF. Product water is usually under 200 ppm tds but is treated after desalination for use in the power plant which needs ultra-pure water for steam. Waste brine is mixed with the cooling water from the power plant before the combined effluent is discharged to the ocean. The desalination plant is located on about one acre. The product water is only used onsite and costs about $2,000/AF to produce.(Source: pers. comm. with Mike Peterson, PG&E, 1991; Tom Wilson, PG&E, 1993.)
- At the **PG&E Morro Bay Power Plant**, exhaust steam from the power plant's boiler is used in a desalination facility consisting of five Vapor Compression distillation units. The plant produces 430,000 gpd of water with less than 1 ppm tds that is used for boiler make-up water. PG&E received a license for the power plant before 1950, so the Commission did not review the desalination facility.
- At the **PG&E Moss Landing Power Plant**, exhaust steam from the plant's boiler is used in a Mechanical Vapor Compression Evaporator desalination plant. The plant produces a maximum of 475,000 gpd of water with about 1 ppm tds that is used for boiler make-up water. PG&E received a license for the power plant before 1950, so the Commission did not review the desalination plant.
- The **U.S. Navy's San Nicolas Island** temporary RO desalination unit began operation in November 1990. The plant produced 24,000 gpd of potable water for Navy personnel on the Island. In July 1992, the Navy replaced the temporary unit with two permanent RO units that produce 16 AF/yr each. The RO units use feedwater from ocean wells and discharge approximately 67,000 gpd of brine into a gravel pit 300 feet from the beach. The Navy monitors the discharge, which has a concentration of about 40,000 ppm tds, to ensure that salinity levels do not increase offshore. Backwashing of the membranes will discharge some particles but not any chemicals (chemicals used in the process are caught and discharged in a sewage plant outfall). No solid waste sludge is generated. The size of each RO unit is about 8 x 10 feet. The cost to produce the water is about $6,000/AF. (Source: pers. comm. with Diane Bentley, Point Mugu NAWS, 1993.) In October 1990, the State Water Resources Control Board (SWRCB) granted the Navy an exemption to the California Ocean Plan for discharging brine in an Area of Special Biological Significance, conditional on compliance with RWQCB NPDES permitting requirements.

Status of Other Proposed Coastal Desalination Projects

- The **Alameda County Water District (ACWD)** completed a reconnaissance level desalination feasibility study in Fiscal Year 1992-93 that consisted of: 1) a survey of current desalination technology and practices; 2) an investigation of the RO process for three different applications (brackish water, municipal wastewater, and seawater); and 3) cost analysis of alternatives. The following is a summary of costs for a modular 5 MGD plant in Alameda County:

Desalination Source Water	*Capital Cost ($)*	*Product Cost ($/AF)*
Brackish groundwater	7,000,000–10,000,000	440–500
Municipal wastewater (excludes cost of pretreatment and distribution)	6,400,000	540
Seawater	20,300,000	1,300

The ACWD is currently updating its 25-Year Water Resources Master Plan and will use the above results for comparison against other water resource alternatives to improve its future water supply reliability. According to the ACWD, desalination of brackish groundwater has the greatest potential at this time. (Source: pers. comm. with James Beard, ACWD, 1993.)

- The **Cambria Community Service District (CCSD)** is seeking to develop a 1 MGD RO plant to provide for drought situations and to ensure an adequate water supply for future development. As proposed, the plant will be constructed in three phases (0.288 MGD, 0.36 MGD, and 0.36 MGD) to allow for incremental growth as well as flexibility in dealing with future drought scenarios. Feedwater for the plant would consist of either seawater from a new ocean intake or brackish water from wells. A preliminary siting study (to be released in October 1993) has identified three potential sites for the plant. The CCSD Board of Directors will make a preliminary siting determination by January 1994. The CCSD plans to conduct an EIR in 1994, to obtain necessary approvals and permits by Spring 1995, and to begin operations by January 1996. (Source: pers. comm. with David Andres, CCSD, 1993.)
- The **Channel Islands Beach Community Services District (CIBCSD)** recently completed Phase I of a Future Water Supply Feasibility Study. The study evaluated six alternative water resources available to the CIBCSD and five treatment processes to meet the District's water quality goals (500 ppm tds and 170 ppm hardness). A conjunctive use groundwater desalination project using a new RO plant was identified as a reliable and cost-effective supplemental, long-term water source. Phase II of the study, which is expected to last six to twelve months, will refine the project description, initiate preliminary design and engineering work, and begin environmental review and permitting. A final decision to proceed with construction of a conjunctive use groundwater desalination plant is anticipated in January 1994. (Source: pers. comm. with Gerard Kapuscik, CIBCSD, 1993.)
- In 1992, the majority of voters in the **City of Buenaventura** selected desalination over completing a connection to the State Water Project as the preferred alternative for the City's next water supply. In 1993, the City began preliminary work on a desalination program. RO will probably be the desalination technology selected, but others are being considered. Hydrogeologic testing is underway to determine the feasibility of using seawater wells; If wells are not feasible, a new ocean intake will be needed. Evaluations are also underway to determine the feasibility of using one of the City's abandoned wastewater outfalls for brine discharge. The earliest anticipated startup date for the proposed facilities is 1997. Preliminary evaluations indicate that the facility should produce approximately 5,000 AF/year in Year 2000 and 7,000 AF/yr in Year 2010. The estimated cost to collect the seawater, produce and pressurize the potable water, and dispose of the brine is $1,900/AF. A CDP would be required in accordance with Coastal Act provisions. (Source: pers. comm. with Glen McPherson, Boyle Engineering, 1993.)
- The **City of Fort Bragg** is evaluating the feasibility of using desalination to augment the City's water supply. (Source: pers. comm. with Scott Cochrane, City of Fort Bragg, 1993.)
- The **City of Goleta** has indefinitely postponed development of a 3,000 AF/yr desalination plant. The City is presently part of the Santa Barbara desalination project with a contract capacity of 3,069 AF/yr. (Source: pers. comm. with Mike Kanno, City of Goleta, 1993.)
- The **City of Lompoc** has tabled a proposal for a seawater desalination facility and is studying other water supply options at this time. (Source: pers. comm. with Greg Veele, City of Lompoc, 1993.)
- The **City of San Luis Obispo** City Council voted in April 1991 to put the City's proposed desalination project on hold after a higher-than-expected rainfall in March 1991. Future desalination plans are indefinite. (Source: pers. comm. with John Moss, City of San Luis Obispo, 1993.)
- The **Los Angeles Department of Water and Power (LADWP)** has completed a study of the feasibility of integrating new desalination plants into the operations of three of its coastal power plants in Los Angeles. The LADWP's plans to pursue desalination as a water supply alternative are currently on hold. (Source: pers. comm. with Thomas Dollente, LADWP, 1993.)
- The **Marin Municipal Water District (MMWD)** constructed a pilot RO plant on San Francisco Bay in October 1990. The plant operated for three months and produced about 25,000 gpd of drinking water. The pilot project results showed the relative effectiveness of various pretreatment chemicals, and preference by the public for the taste of the desalination product water over other drinking water sources. The Bay Conservation Development Commission issued a permit for the pilot plant that required that the facility be completely removed at the end of the pilot project.

Although an EIR was completed for a permanent desalination facility, the MMWD Board of Directors voted in July 1991 not to build a permanent plant. **[3]** The desalination plant proposal was for a two-pass RO plant that produced water with 100-200 ppm tds. The plant capacity was intended to be about 5 MGD initially and 10 MGD ultimately. Recovery was estimated to be about 47%. The cost to produce the water was estimated at $1,600-1,700/AF. Energy use by the plant was estimated at 4,900 kWh/AF. The proposed project site was 7.5 acres. The plant would have taken seawater from a newly constructed intake and discharged about 6 MGD of liquid wastes to San Francisco Bay through the Central Marin Sanitation Agency's outfall. In addition, about 11 tons per day of non-toxic solid wastes would have been disposed of in a landfill. The MMWD is not planning to renew the proposal for a desalination plant at this time. (Source: pers. comm. with Robert Castle, MMWD, 1991, 1993.)

- The **Marina Coast Water District (MCWD)** has completed a feasibility study of desalination plants, either along the coast or inland. The study investigates plants of 1.0, 2.5, and 3.5 MGD that could supply all or part of the City's 3,000 AF annual consumption. The study indicates that 1) beach well collectors at a coastal site, with the possibility of reverse exfiltration galleries for brine disposal, in conjunction with RO may be the least costly facility in terms of capital, maintenance, and operation costs and 2) brackish water desalination provided from inland wells contaminated by seawater may be considerably more expensive due to unknowns in the various parameters of raw material and treatment requirements. For the beach facility, a coastal development permit would be required in accordance with Coastal Act provisions. (Source: pers. comm. with Malcolm Crawford, MCWD, 1993.)

- In rural **Mendocino County**, a few property owners are considering building desalination plants to supply water for a single residence or for neighboring residences (the property owners have not been able to obtain water by other means and cannot build on their property without a water supply). To date, no permit applications for plants of this size have been submitted to the Coastal Commission.
- In 1992, the **Metropolitan Water District (MWD) of Southern California** completed an action plan on a program to determine the potential savings in capital costs of building large-scale seawater desalination plants on the Southern California coastline. The MWD is currently building a 2,000 gpd distillation test unit to test the durability and cost benefits of materials. The test unit would begin operation in 1994 and operate for about one year. Following successful operation of the test unit, the MWD would build a 5 MGD demonstration plant to verify environmental impacts, water quality, energy use, and actual water costs for large-scale units. Construction of the proposed demonstration plant, which would use steam energy from an electrical plant for distillation, is slated to be completed in 1996. Pending a successful demonstration, the MWD will be prepared to participate in building a 50-100 MGD desalination plant in conjunction with an existing coastal power plant upgrade project around the year 2000. A large-scale plant is expected to be cost-effective only if developed and used in conjunction with a coastal power plant upgrade project. The MWD is considering use of one of thirteen existing coastal power plants for the demonstration plant. The cost to produce water from the large-scale desalination plant will be about $700/AF. CDPs for the plants would be required in accordance with Coastal Act provisions. (Source: pers. comm. with David Dean, MWD, 1991, 1993.) In addition, the MWD has deferred plans to build a 100 MGD desalination plant on the Baja coast of Mexico. The plant would have used both distillation and RO technologies. The cost to produce the water in Mexico would have been about $1,200/AF; after adding the cost to pump product water northward across the border, the final estimated cost in California was approximately $1,600/AF.
- The **Monterey Peninsula Water Management District (MPWMD)** Board has decided not to proceed with desalination in the near future after voters in June 1993 defeated a proposal to build a desalination plant in Sand City. (Source: pers. comm. with Andrew Bell, MPWMD, 1993.)
- The **North Coast County Water District (NCCWD)**, which serves the City of Pacifica and environs, is continuing to investigate desalination as an alternative source of water supply. The NCCWD completed a desalination feasibility study in March 1992 and has organized a 15-member citizens advisory committee to investigate the matter further. Currently, all water supplies are received from the City of San Francisco. (Source: pers. comm. with Dave Stevens, NCCWD, 1993.)
- The **Orange County Water District (OCWD)** intends to build a new 10 MGD RO facility for treating wastewater. The OCWD has proposed to locate the plant on the coastline at the Alamitos Barrier. Treated water will be injected to prevent saltwater intrusion. A CDP would be required in accordance with Coastal Act provisions. The proposed project would be similar to the Orange County Water Factory 21, a 5 MGD RO plant that the OCWD has operated since 1977. This plant takes brackish feedwater at 1,100 ppm tds, treats it to 82 ppm tds, then injects the treated water at the Talbert Gap area along the coastline to prevent saltwater intrusion and to allow reuse of the treated water. The cost of producing the water is $500 to $1,000/AF. Orange County Water Factory 21 is not located in the coastal zone and did not require a CDP from the Coastal Commission.
- Plans for construction of an RO desalination plant associated with the **Sands of Monterey** private development project in Sand City are currently indefinite. (Source: DWR *Overview of Desalting in California*, 1992.) A CDP for the plant would be required in accordance with Coastal Act provisions.
- The **San Diego County Water Authority (SDCWA)** is continuing to evaluate the feasibility of siting a desalination plant adjacent to an existing power plant located at the southern end of San Diego Bay. The project would consist of an RO plant powered by steam or electrically driven pumps. Steam for the desalination plant would be generated using excess heat from the power plant. A phased implementation is being planned. Phase I would consist of a 5 MGD facility, using a portion of the excess heat from the power plant. Phase II would increase the capacity of the plant to 15 MGD and would use all available excess heat from the power plant. Phase III would increase the output of the desalination facility to 30 MGD using electric motor drives for the remaining capacity. Brine would either be mixed and discharged with the power plant cooling water, or disposed of via an ocean outfall. The cost of water from this facility is projected to be $1,100 to $1,300/AF. Phase I could be completed by late 1997. (Source: pers. comm. with Bob Yamada, SDCWA, 1993.)
- In October 1992, the **U.S. Navy** submitted a consistency determination to the Coastal Commission to install two RO desalination plants at existing cogeneration power plants at the **North Island Naval Air Station** and the **32nd St. Naval Station**, San Diego. The desalination plants would operate 21 hours per day and generate approximately 700,000 gpd of fresh water for use as boiler make-up water for production of steam-generated electricity. The Navy proposes to take feedwater for the desalination plants from seawater wells and to discharge brine through diffusers located on existing piers extending into San Diego Bay. A 0.3 MGD discharge is proposed from the North Island Naval Air Station and a 0.7 MGD discharge is proposed from the 32nd St. Naval Station. In October 1992, toxicity studies on a simulated batch of the proposed North Island effluent were performed for the RWQCB, San Diego Region. The results showed that

the simulated effluent would be acutely toxic to marine organisms and, therefore, would not be in compliance with the RWQCB's Enclosed Bays and Estuaries Plan (EBEP). The Navy has indicated that it plans to request that the SWRCB grant an exception to the EBEP's narrative requirement that there be no acute toxicity in a mixing zone. The Commission's consistency determination is on hold pending issuance of the exception request and issuance of NPDES permits for the desalination discharges by the RWQCB.

ENDNOTES

1. The County has the authority to enforce health laws, rules, and regulations in the City of Monterey because the City has consented by resolution or ordinance to the county health officer exercising that authority. (Public Resources Code, Section 476.)
2. The Coastal Commission's "consistency review" of OCS structures and their associated desalination units began in 1978 with certification by the National Oceanic and Atmospheric Administration (NOAA) of the California Coastal Management Plan (CCMP). Only those desalination units on Platforms Gail, Habitat, Harvest, Hermosa, and Hidalgo were reviewed by the Commission as part of their operators' respective Development and Production Plans (DPPs).
3. The MWWD Board instead selected the Russian River as the preferred water source and placed an $80 million bond measure on the November 1991 ballot to fund that project. Desalination was mentioned on the bond measure as a contingency plan if certain contractual and institutional constraints prevented the Russian River project. The bond measure was defeated. In November 1992, a subsequent bond measure for $37.5 million was passed to fund expansion of water recycling, conservation, and water imports.

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California Coastal Commission

Seawater Desalination in California

CHAPTER THREE: *POTENTIAL ENVIRONMENTAL IMPACTS / COASTAL ACT ISSUES*

Development in the coastal zone must conform to the policies and standards of the California Coastal Act and, if applicable, the Commission-certified Local Coastal Program (LCP) of the government with jurisdiction in the area of the proposed development. The Coastal Commission reviews projects on a case-by-case basis and considers the environmental benefits and coastal zone impacts of all projects. The following types of potential coastal zone impacts should be considered and addressed for desalination plants:

- Construction
- Energy Use
- Air Quality
- Marine Environment

- Increased Development
- Other Coastal Zone Issues (geologic hazards, navigation, cumulative effects, etc.)

These impacts, related Coastal Act policies, and potential mitigation measures are discussed below.

Construction

- **Impacts/Related Policies**

Construction activities could result in the following types of coastal zone impacts: air emissions; disturbance of dune, surf zone, and seafloor ecology; disturbance to seabirds, marine mammals, other land and marine species, and their habitats; disturbance to archaeological and paleontological resources; erosion; interference with public access and recreation; noise; nonpoint source pollution; and obstruction of views by machinery, piping, or tall structures.

Significant construction impacts may also occur away from the desalination plant site if long pipelines are needed for seawater intake or for distribution of the product water, or if power transmission lines or distribution facilities must be built. Pipeline routes may have adverse impacts on benthic habitats such as surfgrass and rocky tidepools. Streambed or lagoon ecosystems along proposed power transmission line routes would be of particular concern. Any proposed diking, filling, or dredging activities in open coastal waters, wetlands, or estuaries must be in compliance with Section 30233 and other sections of the Coastal Act.

- **Potential Mitigation Measures**

- Minimize the numbers and lengths of pipelines and power transmission lines;

- Site pipeline routes to minimize impacts to sensitive areas;

- Site plants in locations where existing intake or outfall structures may be used or minimize the size of new seawater intake and outfall structures; and

- Incorporate mitigation measures commonly required for construction activities (e.g., construction schedules that minimize impacts on public access and recreation, visual screening, noise buffers, siting away from high resource areas, limited construction zones and corridors, etc.).

Energy Use

- **Impacts/Related Policies**

Desalination plants require significant amounts of energy for their operation. For example, the Santa Barbara RO desalination plant was using about 6,600 kWh of electricity per acre-foot of water produced before the plant shut down operations. In most cases, RO plants are less energy intensive than distillation plants.

Section 30253(4) of the Coastal Act requires that new development minimize energy consumption. Consequently, the Commission will review desalination plant proposals to determine if a project incorporates means to conserve energy or reduce energy use. The Commission should also consider the secondary impacts resulting from the increase in power production needed for the desalination plants. These impacts include higher levels of air emissions, increased entrainment and impingement of fish from intake of cooling water, higher levels of cooling water discharges to the ocean, and effects from additional transportation of oil and gas.

- **Cogeneration**

Cogeneration is a process in which exhaust steam from electricity generating plants is used for another purpose. If a desalination plant uses cogeneration to supply part of its energy needs, the plant could reduce both its demand for power and the associated environmental impacts of power generation.

For example, a distillation plant can use the heat in a power plant's exhaust steam to evaporate feedwater. A cogeneration power plant that operates with a distillation plant, however, must be specially designed for that purpose. A distillation plant that is dependent on a power plant's exhaust steam for its operation would not be able to operate when the power plant is not operating. (The capacity factor for most thermal power plants is not more than 75%.)

An RO plant may also use exhaust steam from a power plant to heat feedwater slightly (too high temperatures can damage the RO membranes). In this application, the RO plant depends on electricity to power its high pressure pumps; the thermal heat from the power plant improves the production of the desalination process but does not power the plant. Therefore, RO plants can operate with or without the heat from the power plant, and the power plant does not have to be specially designed to fit with the desalination plant. Cogeneration can also be used in RO plants by using exhaust steam in a steam turbine to power the pressure pumps. (Figure 3.)

A third option for cogeneration is in a hybrid plant that uses both RO and distillation (e.g., MSF) technologies. Existing power stations can and have been "retrofitted" in the evaporators and RO units to achieve a hybrid plant, thus eliminating the need to construct a new desalination facility. The MSF plant draws waste steam from a thermal power station and uses the energy in the steam to preheat seawater which is then distilled in the MSF unit. The RO unit uses electricity from the power station and operates during periods of reduced power demand, thus optimizing the overall efficiency of the entire operation. Advantages of the hybrid design include: reduced energy costs (the distillation portion would have energy savings from cogeneration, while the RO portion could use electricity from the grid to produce water when the power plant is not in operation) and reduced capital and operating costs from reuse of cooling water, feedwater or steam.

Although distillation plants usually have higher overall energy requirements than RO plants, the potential energy savings from cogeneration are greater for distillation plants. According to one estimate, use of cogeneration at an RO plant that produces 15,000 AF/yr could reduce electricity consumption by about 7%. (Source: Southern California Gas Company, 1991.) According to another estimate, for an RO plant that produces 50,000 to 60,000 AF/yr of water and that uses the exhaust steam from a power plant to heat the feedwater 20°F, the electricity demand could be reduced 10 to 15%; for a distillation plant of the same capacity that uses cogeneration, the reduction in demand for additional energy sources could be 20 to 25%. (Source: pers. comm. with Mark Skowronski, SCE, 1991.)

One option being considered is to design and build a new power plant to operate in conjunction with a desalination facility. A power plant designed specifically for cogeneration with a desalination plant could produce lower air emissions than existing power plants if the new plant is fired with natural gas and uses the latest air emission control technologies. However, construction and operation of a new power plant could have a number of adverse impacts including air emissions, impacts on marine resources, degradation of visual and recreational opportunities, disturbance of sensitive habitat areas, and increased growth in coastal communities.

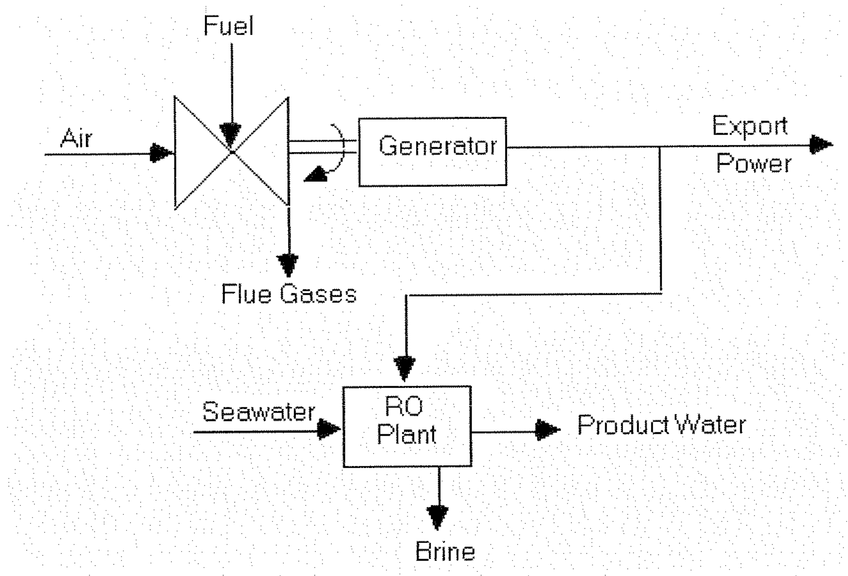
- **Other Options for Saving Energy**

One method for reducing energy use in all types of desalination plants is by employing energy recovery. In the case of distillation, heat in the brine and fresh water leaving the plant is used to preheat the feedwater. In RO, energy is recovered by converting hydraulic pressure in the brine to electricity or by transferring this energy to the feedwater.

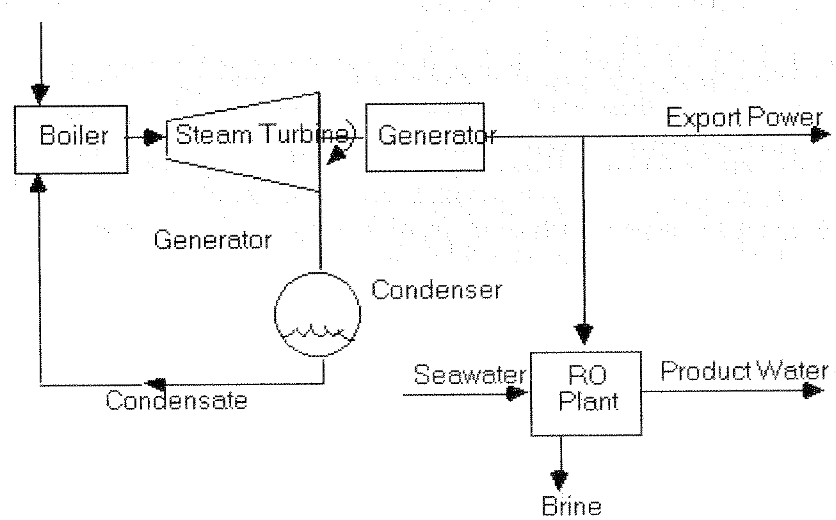
Solar energy could also be used to heat the water for a small distillation plant. Solar energy is expensive compared to other desalination technologies and may require a larger area for the solar energy gathering and conversion devices; however, this technology would not produce toxic air emissions and would not consume exhaustible resources.

Ocean Thermal Energy Conversion (OTEC) is an offshore technology for producing electricity where the difference in the temperatures of deep ocean water and warm surface water is used to vaporize liquid ammonia for turning a turbine. The turbine drives a generator that provides power for the water pumping system. Warm surface water is evaporated in a partial vacuum and the condensed fresh water is shipped back to land in a tanker from the offshore location (e.g., a floating production platform). OTEC was evaluated by various federal agencies in the 1960s and 1970s and was found to be commercially viable, though expensive. One company has recently developed a proposal to use OTEC, but so far none of the municipalities or companies that are planning desalination plants have decided to use this technology. OTEC would not produce toxic air emissions and would not consume exhaustible resources, other than from the tankers used to ship the water.

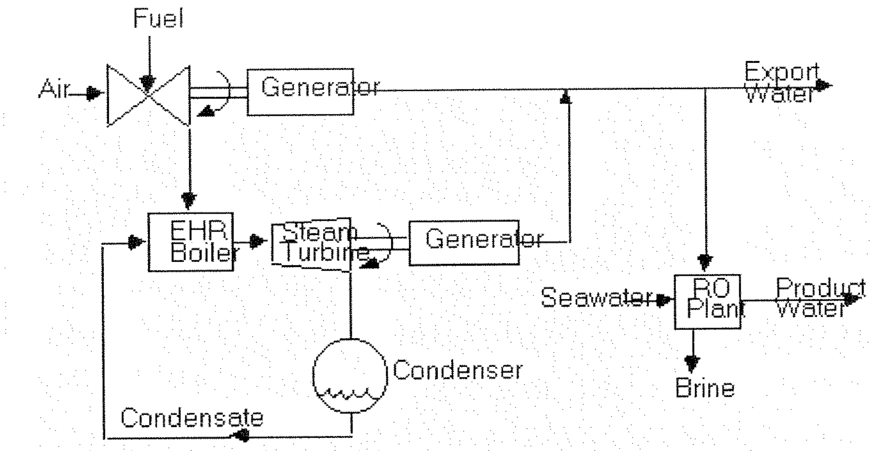
Figure 3. Cogeneration options.



Reverse Osmosis and Gas Turbine Cogeneration



Reverse Osmosis and Steam Turbine Cogeneration



Reverse Osmosis and Combined Cycle Cogeneration

- **Potential Mitigation Measures**

- Preference for desalination technologies and plant designs that reduce energy consumption;

- Use of renewable energy resources, when feasible; and

- Siting of the proposed plants near to power plants capable of cogeneration.

Air Quality

- **Impacts/Related Policies**

Section 30253(3) of the Coastal Act requires that new development be consistent with requirements imposed by an air pollution control district or the State Air Resources Control Board as to each particular development. In general, desalination plant air emissions consist only of discharges of nitrogen and oxygen from distillation plants that use deaeration processes to reduce corrosion, discharge of the air ejector system (thermal plants), or discharge of the degassifier (RO plants).

The production of energy for use in desalination plants, however, will increase air emissions. In addition, substantial increases in air emissions could occur if a new power plant or cogeneration facility is built for a desalination project. Some of the proposed plants would be built in areas where air quality violations already exist; consequently, the plant designs should include consideration of measures to offset air emissions from energy production.

- **Potential Mitigation Measures**

- Compliance with local Air Pollution Control District and State Air Resources Board standards;

- Preference for reduced energy use, as discussed above; and

- Use of alternative energy sources to minimize air emissions.

Marine Environment

- **Related Policies**

Marine resources in the vicinity of a desalination plant can be affected by the constituents present in the waste discharges, by the waste discharge method used, and by the process of feedwater intake. Coastal

Act Sections 30230 and 30231 provide for the maintenance, enhancement, and restoration of marine resources and biological productivity. Specifically, Section 30230 provides:

> "Marine Resources shall be maintained, enhanced, and where feasible restored. Special protection shall be given to areas of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."

Section 30231 states in part:

> "The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment...."

In addition to these Coastal Act policies, Section 307(f) of the Federal Coastal Zone Management Act (CZMA) provides that for purposes of the Commission's exercise of its consistency review authority under CZMA Section 307(c), federal, state, and local provisions established pursuant to the Clean Water Act (CWA) shall be incorporated into state coastal management programs and shall be the water pollution control requirements applicable to such program. Consequently, a number of the general policies and objectives of the California Ocean Plan are incorporated directly into the California Coastal Management Plan (CCMP). In addition, Coastal Act Section 30412(a) specifies that the provisions set forth in Section 13124.5 of the State Water Code shall apply to the Commission, while Coastal Act Section 30412(b) states that the SWRCB and the RWQCBs are the state agencies with primary responsibility for the coordination and control of water quality.

- **Constituents of Waste Discharges from Desalination Plants**

The constituents of water discharged from desalination plants depend in part on: the desalination technology used; the quality of the intake water; the quality of water produced; and the pretreatment, cleaning, and RO membrane storage methods used.

All desalination plants use chlorine or other biocides, which are hazardous to marine resources, to clean pipes and other equipment and sometimes to pretreat the feedwater. The State RWQCBs do not permit chlorine or other biocides to be discharged directly into the ocean. Consequently, these chemicals would have to be neutralized before discharge.

Alternative treatment processes and technologies that eliminate the need for biocides can also be used. For example, ultraviolet light may be used instead of biocides to remove biological organisms. Ultraviolet light is more expensive than biocides but is an effective method. Similarly, the disc tube RO technology, which has been used primarily in Europe, does not require use of pretreatment chemicals to remove particles and organisms. This technology, unlike the more common spiral wound RO technology, does not have a mesh net between layers of the RO membranes (the net catches particles and biological organisms and can clog the membranes). The disc tube technology, however, is more expensive than the spiral wound technology and, according to one source, is unproven on seawater desalination. (Source: Dick Sudak, Separation Processes, 1992.) The need for pretreatment chemicals and processes can also be eliminated or reduced substantially if feedwater is taken in from beach wells or infiltration galleries, which serve as natural filters. (An infiltration gallery has perforated pipes arranged in a radial pattern in the saturated sand onshore, and water in the sand seeps into the perforated pipes.)

Some RO plants use a coagulant (usually ferric chloride), as part of the pretreatment process to cause particles in feedwater to form larger masses that can be more easily removed with filters before the water passes through to the RO membranes. The pretreatment filters are backwashed with filtered seawater every few days, producing a sludge that contains filter coagulant chemicals. Options for disposal of coagulants, particles and sludge removed from the filters include discharge with the brine, transport to a landfill, or a combination thereof. A desalination plant would have to include a process for removal of the particles if they are to be discharged with the sludge. Ferric chloride is not toxic but may cause a discoloration of the receiving water if discharged.

Desalination plants often use anti-scalants to remove scales that form on the plant's interior. Most plants use a polyacrylic acid as an anti-scalant, which is not hazardous to marine resources. MSF distillation plants may use a small quantity, about 0.1 milligrams for each liter of water, of an antifoaming agent (similar to cooking oil) to reduce the foam produced when the water boils.

In RO plants, cleaning and storage of the membranes can produce potentially hazardous wastes. The membranes must be cleaned at intervals from three to six months depending on feedwater quality and plant operation. The membrane cleaning formulations are usually dilute alkaline or acid aqueous solutions. In addition, a chemical preservation solution (usually sodium bisulfite) must be used if the membranes are stored while a plant is shut down. These chemicals should be treated before discharge to the ocean to remove any potential toxicity.

In general, discharges from desalination plants may have the following types of potentially adverse constituents and qualities:

- Salt concentrations above those of receiving waters (seawater salt concentration is about 35,000 ppm; desalination plants discharge brine with 46,000 to 80,000 ppm). Salt concentrations may be reduced by mixing desalination plant discharges with other discharges, such as wastewater;

- Temperatures above those of receiving waters (about 5° F increase at the point of discharge) for discharges from distillation plants; (Source: Baum, 1991.)

- Turbidity levels above those of receiving waters;

- Oxygen levels below those of receiving waters from deaeration to reduce corrosion (distillation plants only);

- Chemicals from pretreatment of the feedwater (these may include biocides, sulfur dioxide, coagulants (e.g., ferric chloride), carbon dioxide, polyelectrolytes, anti-scalants (e.g., polyacrylic acid), sodium bisulfite, antifoam agents, and polymers);

- Chemicals used in flushing the pipelines and cleaning the membranes in RO plants (these may include sodium compounds, hydrochloric acid, citric acid, alkalines, polyphosphate, biocides, copper sulfate, and acrolein);

- Chemicals used to preserve the RO membranes (e.g., propylene glycol, glycerine, or sodium bisulfite);

- Organics and metals that are contained in the feedwater and concentrated in the desalination process; and

- Metals that are picked up by the brine in contact with plant components and pipelines.

- **Marine Resource Impacts from Desalination Waste Discharges**

Concern over the potential adverse effects to marine resources of desalination plant discharges is tempered by the following factors: the total volume of brine being released; the constituents of the brine discharge; and the amount of dilution prior to release. For example, the potential for environmental damage from small amounts of brine discharge (less than 1 MGD) may differ considerably from the potential impacts associated with discharges greater than this amount. Discharge of concentrated brine in large amounts requires more careful consideration of potential environmental impacts than do smaller brine discharge volumes. (Source: Dr. Phillip McGillivary, NOAA, 1992.)

The constituents of discharges of particular concern for marine organisms include biocides, high metal concentrations, and low oxygen levels. Not all desalination plant discharges contain these constituents; however, where detected, these constituents should be removed or neutralized to acceptable levels before discharge or else adequately diluted in the ocean in accordance with RWQCB NPDES permit requirements for compliance with the California Ocean Plan and Regional Basin Plans.

The high salt concentration of the discharge water and fluctuations in salinity levels may kill organisms near the outfall that can not tolerate either high salinity levels or fluctuations in the levels (similarly, if a temporary desalination plant is shut down, the organisms that have become accustomed to high salinity levels and/or salinity fluctuations may be killed). In addition, discharges from desalination plants will be more dense than seawater and could sink to the bottom, potentially causing adverse impacts to benthic communities. These effects may be significantly reduced if desalination plant discharges are combined with sewage treatment plant discharges (which are less dense than seawater) or are diluted by mixing with power plant cooling water discharges. At this time, there is considerable uncertainty about how well desalination plant discharges, either alone or combined with other discharges, will be diluted in seawater. The metals may become concentrated in the upper few micrometers of the ocean (the microlayer), which would be toxic to fish eggs, plankton, and larvae that are located there. Toxic constituents of the plume could be driven by wind or currents to become concentrated in the intertidal zone. (Source: pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

Discharge of brine water with high salt concentration, particularly if combined with sewage effluent, may also cause sewage contaminants and other particulates to aggregate in particles of different sizes than they would otherwise. This effect influences rates of sedimentation, and is highly important for determining the well-being of benthic organisms that may be buried or burdened by an increase in deposition of unstable and/or finely suspended materials. If the particles are smaller and stay in suspension, they could interfere with transference of light in the ocean, which would diminish the productivity of kelp beds and phytoplankton. In addition, redistribution of trace metals (e.g., iron, nitrogen, and phosphorus) could change the phytoplankton community to one that is unappetizing to fish and may also be toxic (for example, by increasing the possibility or prolonging the occurrence of a "red tide" condition). Larval fish that feed on the phytoplankton could be forced beyond nearshore waters, where they may not survive. (Source: pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

Changes in salinity and/or temperature from the brine discharges may also affect migration patterns of fish along the coast. If some fish species sense a change in salinity or temperature, they may avoid the area of the plume and move further offshore. As a result, the fish would be forced to swim a longer distance, they would leave the areas of highest food concentrations, and they would have increased exposure to predators. The potential impacts of this nature are uncertain because of limited knowledge about fish migration along the coast and uncertainty about how large the plume would have to be to cause this effect.

- **Waste Discharge Methods**

The brine from desalination plants can be discharged directly into the ocean or combined with power plant cooling water or post-treatment sewage plant discharges. Mixing the discharges with power plant cooling water would most likely be desirable, because the brine solution discharged would be considerably less concentrated. Mixing with sewage treatment discharges may also be preferable to direct discharge to the ocean. Brine discharge from desalination plants is more dense than seawater and could remain or fall to the ocean bottom, depending on the outfall location. Treated sewage effluent has a relatively low level of total dissolved solids, and blended brine/wastewater effluent has the potential to be closer to ambient ocean concentrations, so dispersion may be enhanced beyond a brine-only discharge. The addition of brine discharge to wastewater effluent reduces the biological oxygen demand (BOD) of the sewage effluent and has the potential to reduce the temperature of the sewage effluent. (For more information, see Woodward-Clyde Consultants, EIR for the City of Santa Barbara and Ionics, Inc.'s Temporary Emergency Desalination Project, March 1991.) On the other hand, blending the brine discharge with sewage discharges may have some undesirable side-effects, which are discussed below under Marine Resource Impacts.

Difficulties in enforcement may arise if desalination wastes are mixed with other waste streams. If the recipient of the desalination waste stream is the only party responsible for compliance with the regulatory requirements, this discharger would have to request the desalination plant operator to make changes if problems with compliance develop. If a proposed desalination plant incorporates combined discharges, the project description must identify the party or parties responsible for meeting the discharge requirements in order to avoid enforcement problems.

- **Marine Resource Impacts from Desalination Plant Intake**

Intake of water directly from the ocean usually results in loss of marine species as a result of impingement and entrainment. Impingement is when species collide with screens at the intake; entrainment occurs when species are taken into the plant with the feedwater and killed during plant processes. The intake of feedwater can also affect marine resources by altering natural currents in the area of the intake structure.

The use of beach wells or infiltration galleries eliminates these impacts; however, these intake methods have not been used extensively in California, and the maximum capacity of a plant that could draw feedwater effectively from these sources is unknown. Beach wells should only be used in areas where the impact on aquifers has been studied and saltwater intrusion of freshwater aquifers will not occur. Infiltration galleries are constructed by digging into sand on the beach, which could result in the disturbance of sand dunes.

- **More Information is Needed on Marine Resource Impacts**

Very little information is available on the impacts of desalination plants on the marine environment. For example, few if any monitoring studies have been conducted on the marine resource impacts of discharges from plants operating in the Middle East, Saipan, the Virgin Islands, and Cuba. Although a number of brackish water desalination plants are operating in Florida, these plants are not permitted to discharge directly to the ocean because the ocean waters are shallow out to about 10 to 15 miles from shore and do not dilute the discharges adequately. The brine is discharged either into deep, confined aquifers or to saline streams or lakes that discharge to estuaries.

An extensive analysis was conducted of the impacts of ocean discharges from a MSF desalination plant that operated in Key West, Florida during the 1960s and mid-1970s. The following studies were done to characterize dispersion of the effluent: 1) measurements of the concentration of metals in marine sediments; 2) dye observations and in situ diver observations; 3) temperature inversion analysis; and 4) semiweekly analysis of water conditions, including temperature, salinity, copper, alkalinity, pH, and oxygen. In addition, the following studies were conducted to determine impacts on the biological community:

1) analysis of foraminifera, small shelled protozoans;

2) wooden settlement panels that collected organisms over known exposure times and on substrates that were uniform in size and material;

3) surveys of organisms within transects;

4) laboratory bioassays;

5) surveys of organisms within one-meter square quadrats at twenty monitoring stations;

6) transplants of selected species into particular effluent regimes to study their survival and growth;

7) analysis of biomass samples;

8) collection of benthic diatoms and protozoans in glass microscopic slides in special racks (diatometers);

9) analysis of plankton tows; and

10) Carbon 14 measurements of photosynthesis.

The studies found that the effluent mixed turbulently with ambient water at the point of discharge. The density of this mixture was greater than that of the ambient water in the harbor where the effluent was discharged, so the mixture sank to the harbor bottom, filled up the harbor basin which was deeper than the surrounding waters, and then flowed into more shallow water. The temperature of the effluent averaged about 0.5 to 0.9°F above ambient temperatures and the effluent salinity was 0.2 to 0.5% above ambient salinity. The analyses found that the changes in temperature and salinity did not by themselves cause damage to marine organisms, but did result in lower mixing rates for copper in the effluent. Copper concentrations, which were often 5 to 10 times ambient levels, were found to be toxic to marine organisms. The studies also found that effluent discharged following startup of the plant after maintenance procedures had higher copper concentrations and caused more biological damage than effluent discharged during normal operations. (The high levels of copper detected may have due to a copper grating that was later replaced, not to the desalination process itself. The internal components of many modern desalination plants are composed of titanium rather than copper.) A variety of organisms were adversely affected by the effluent. For example, sea squirts, various species of algae, bryozoans, and sabellid worms were excluded from the harbor during at least a portion of the study; no live lamellibranchs were found by the end of the study; many dead shells of various clams and oysters were found; and echinoids were killed in the shallower waters near the harbor. Two or three of the species that survived well in the area near the effluent did so because they were able to avoid the peaks associated with start-up and were able to tolerate the steady-state effluent conditions. (Source: Chesher, 1975.)

In California, discharges from the desalination unit at the Chevron Gaviota Oil and Gas Processing Plant have been monitored in accordance with the plant's NPDES permit since January 1987. The discharges have been relatively small, because the unit has been operating at reduced capacity. Discharge constituents monitored include: dissolved oxygen, copper, iron, nickel, pH, temperature, total chlorine residual, toxicity concentration in marine organisms (bioassays), arsenic, cadmium, lead, hexavalient chromium, mercury, silver, zinc, cyanide, suspended solids, particulates, grease and oil, settleable solids, flow rate, and turbidity. A plume trajectory study was not conducted, because the computer models used by the RWQCB at the time could not be applied to plumes with salinity levels greater than that of the ocean. (New computer models have since been developed.) The monitoring results to date show no violations of the permit except for high levels of zinc. (The high levels may have been a result of high levels at the intake.) Recent monitoring has shown zinc levels within permitted standards.

The Marin Municipal Water District built a pilot plant and conducted some studies of the impacts of discharges from this plant on San Francisco Bay. Bioassay studies were conducted on two waste streams - the concentrate discharged directly to San Francisco Bay, and the concentrate mixed with effluent from the Central Marin Sanitation Agency (CMSA). The studies performed for each waste stream were the 7-day chronic *Menidia beryllina* test, the 96-hour *Skeletonema costatum* growth test, the 48-hour bivalve larvae test, and the 96-hour acute *Citharichthys stigmaeus* test. The studies found that to achieve the No Observable Effect Concentration (NOEC) for these organisms, the dilution ratio for Bay water to effluent would have to be 23:1 for unmixed concentrate and 20:1 for concentrate mixed with the CMSA effluent. The study also found that the quality of the CMSA effluent was improved by mixing it with the pilot plant discharges, because the salinity increased and the buoyancy was reduced. (Source: Boyle Engineering Corp. for the Marin Municipal Water District, 1991.)

The Southern California Coastal Water Research Project (SCCWRP) Toxicology Laboratory recently completed a study of potential effects resulting from the discharge of effluent from the City of Santa Barbara desalination plant. The research was conducted for use in an EIR for the City's Long-Term Water Supply Program. The SCCWRP conducted experiments to measure the effect of elevated salinity on sensitive marine species likely to be found in the vicinity of the Santa Barbara discharge to determine if salinity stress affected an organism's sensitivity to sewage toxicity, and to document the level of toxicity in brine resulting from chemicals added during the desalination process. According to the SCCWRP, the experiments indicated that a salinity of 36.5 g/kg (the maximum expected to occur at the Santa Barbara discharge site) did not produce measurable effects on amphipod survival or giant kelp growth; however, an inhibition of sea urchin embryo development at this salinity was measured. Additional studies are needed to confirm the data and determine their applicability to other discharge situations. (Source: SCCWRP, *Coastal Currents*, Vol. 2, No. 1, Summer 1993.)

Other existing desalination plants in California have been operating only for only a short time or are very small, so the impacts of discharges from these plants cannot be compared with potential impacts from larger plants. The Santa Catalina Plant, which began operating in June 1991, is located near Areas of Special Biological Significance (ASBS), as designated by the SWRCB. The results of monitoring studies for this plant should be reviewed closely by the Commission staff to determine whether any adverse impacts have occurred and whether the staff should recommend that any changes be made to mitigation and monitoring requirements in the plant's NPDES permit.

- **Pre-Operational Monitoring and Baseline Information on Marine Resources**

The following types of pre-operational baseline information would be useful for the Coastal Commission to have in evaluating the marine resource effects of desalination plant discharges.

- Studies of the effects of discharges from a pilot plant built where a final plant will be located;

- Measurements of dispersion rates to determine how readily brine will disperse in the ocean;

- Laboratory studies to determine the effect on particle size of mixing brine and sewage water;

- Laboratory studies to determine the dispersion of metals;

- Tracer studies using small quantities of nonradioactive isotopes of metals to determine the quantity of metals that end up in the ocean microlayer;

- An inventory of marine organisms in the area of the outfall; and

- A long-term inventory of marine organisms in the microlayer.

(Sources: Post-operational monitoring recommendations from Woodward-Clyde Consultants, 1991; pers. comm. with Dr. Phillip McGillivary, NOAA, 1991; pers. comm. with Sorrel Davis, RWQCB, Central Coast Region, 1991.)

- **Post-Operational Monitoring of Marine Resources**

- Secchi Disk Depth Test to measure how much light is penetrating the water column (to determine whether there may be an impact on the benthos);

- Measurements of impacts on habitat in the microlayer;

- Measurements of impacts on fish in the water column;

- Plume trajectory evaluation of depth, temperature, salinity, and density;

- Nontoxic dye tests to measure dilution;

- Sampling of sediments; and

- Measurements of salinity at various offshore sampling locations.

(Sources: Woodward-Clyde Consultants, 1991; pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

- **Potential Mitigation Measures to Reduce Marine Resource Impacts**

- Intake and outfall siting and design to avoid sensitive locations;

- Low flow velocities at intake channels and through intake structures to minimize entrainment and impingement of marine species and to reduce the need for pretreatment;

- Intake design to reduce the potential for entrainment and impingement (e.g., screens at the intake to reduce entrainment);

- Use of onshore intake wells or infiltration galleries to eliminate entrainment of marine species;

- Outfall siting and design to ensure an adequate mixing rate and dilution volume to minimize adverse impacts;

- Outfalls to the open ocean, not to estuaries or other areas with limited water circulation;

- Use of pretreatment techniques that minimize or eliminate the need for hazardous chemicals;

- Removal of hazardous constituents in the brine waste stream prior to discharge;

- Evaluation of whether landfill disposal would have more or less impacts than ocean disposal;

- Mixing with sewage treatment plant or power plant cooling water discharges (when mixing of discharge streams is intended, ensure that a desirable proportion of each discharge is maintained to enhance dilution);

- Use of pipes that minimize the corrosion of hazardous substances (polyethylene or titanium is preferable to copper nickel); and

- Timing of operations to minimize impacts (e.g., intermittent operations to minimize discharges at times during the lunar month when fish migrations are highest; or operation only during the winter season when the ocean is more turbulent, and discharges would be more readily diluted).

Increased Development

- **Potential Growth-Inducing Impacts of Providing Desalinated Water/Related Policies**

Section 30250(a) of the Coastal Act requires that new development be located within or next to existing developed areas able to accommodate such development, or in other areas with adequate public services. Section 30254 provides that new public works facilities be "designed and limited to accommodate needs generated by development or uses permitted consistent with the provisions of this division." If applicable, new development must also conform to the policies and standards contained in the Commission-certified LCP of the local government with jurisdiction in the area of the proposed development. Such policies may relate to the allocation of limited water resources or to other regional water and growth management goals.

The construction of desalination plants to meet water supply needs in the state may result in growth-inducing impacts. Limited water is often the major constraint to development in many parts of the coast. Therefore, new desalination projects in coastal areas could lead directly to new development and a resulting increase in population migration to coastal areas. New development served by the plant could in turn interfere with long-term regional goals for growth control. For example, desalination plants built in rural areas could lead to growth in these areas rather than within existing urban boundaries; desalination plants built in urban areas may also change the character of these areas.

The Coastal Act mandates that certain types of development receive priority over other development. These higher priority developments include: lower cost visitor and recreation facilities (Section 30213); visitor-serving commercial recreational facilities designed to enhance public opportunities for coastal recreation (Section 30222); aquaculture facilities (Section 30222.5); facilities serving the commercial fishing and recreational boating industries (Section 30234); and coastal-dependent development (Section 30255). The most effective way to ensure proper implementation of these and other Coastal Act or LCP development priorities in areas where desalinated water may need to be produced is to achieve these development priorities through zoning and other standard land use regulatory devices. Because public ownership and operation of desalination plants can also be expected to assist in ensuring that water allocations will occur in a manner that is consistent with the foregoing development priorities, the Commission may need to consider special or additional conditions in connection with any approvals it may grant for privately-owned desalination plants.

Potential growth-inducing impacts should be considered for those communities that receive the water, as well as those where the desalination plants will be located. The Commission and local governments should consider, on a regional scale, the pros and cons of building a number of small plants versus a few larger ones. Growth-inducing impacts may be more significant for projects that operate for many years, as compared to those that are short-term projects for drought relief. The Commission should consider the potential long-term impacts of extending the life of projects that are presently intended for short-term use.

- **Potential Mitigation Measures to Minimize Growth-Inducing Impacts**

- Strong, community-wide water conservation and reclamation measures to reduce the need for new water projects;

- Siting of plants near existing seawater intake facilities (e.g., intake pipelines or seawater wells);

- Siting of plants near existing energy sources and distribution systems;

- Siting of plants near existing fresh water distribution mains to distribute the product water;

- Sizing of plant capacity to be commensurate with the planned level of development authorized by the certified LCP for the area;

- Assessment of the long-term growth-inducing impacts of proposals for long-term projects and for projects that are intended to be temporary, but may become permanent in the future; and

- Coordination of project approval with regional growth management goals.

Other Coastal Zone Issues

- **Impacts**

The following potential coastal zone impacts should be considered in evaluating proposals for desalination plants:

- Impacts to the marine environment from accidental discharges of hazardous materials;

- Impacts to commercial fishing and navigation during construction of intakes and outfalls and during operation;

- Interference with public access and recreation from pipelines, wells or other structures;

- Visual impacts - towers for most distillation plants will be 30 to 46 feet high; RO plants are usually not more than 15 to 20 feet high;

- Impacts resulting from geologic hazards and seismic activity;

- Noise from pumps during operation;

- Impacts on the desalination process from pollution near the intake pipes (e.g., discharges from other sources, oil spills, etc.);

- Use of landfill disposal space for solid waste disposal;

- Impacts from increased chloride concentration - RO product water may have higher levels of chlorides than other water sources (using product water with high levels of chloride for irrigation may result in more water use and adverse impacts on soils; chloride levels can be reduced by employing more passes

[RO plants] or by using a different process [e.g., MSF, MED, VC]); and

- Cumulative impacts of the desalination plants in the coastal zone.

- **Potential Mitigation Measures to Minimize the Impacts Listed Above**

- Quality control procedures and personnel training to avoid accidents;
Secondary containment for chemical feed lines and provisions for leak detection;

- Notification of commercial fishing interests and the U.S. Coast Guard prior to construction;
Placement of navigational buoys on any new intakes and outfalls;

- Provisions for public access and timing of construction to avoid peak recreational periods;

- Architectural design and natural buffers to reduce visual impacts;

- Preliminary siting studies of potential geologic hazards conducted by geologists or engineering geologists licensed in the state of California;

- Equipment enclosures to reduce noise levels;

- Siting to avoid pollutants near the intake; and

- Recycling or reuse of solid wastes.

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CHAPTER FOUR: *REGULATORY AUTHORITY AND LEGISLATIVE ISSUES RELATED TO DESALINATION PLANTS*

Coastal Commission Authority Over Desalination Projects

The Coastal Commission may become involved in the process of reviewing permits for desalination plants or related facilities in several ways. The following is a brief overview of provisions for Commission involvement.

1) If the proposal includes development in an area of the coastal zone where the city or county does not have a fully certified Local Coastal Program (LCP), a coastal development permit from the Commission will be required under Section 30600(c) of the Coastal Act.

2) In areas where there is a certified LCP, a proposed project may be appealable to the Commission under several of the appeal provisions of Section 30603, including appeals of energy facilities and public works projects. The basis for appeals must be that the proposed development does not conform to the certified LCP.

3) Pursuant to Section 30514 of the Coastal Act, the Commission will review LCP amendments that provide for desalination plants.

4) Pursuant to Section 30519(b) of the Coastal Act, the Commission retains permit jurisdiction over any portion of a project that is in state waters, on land up to the mean high tide line, or on lands subject to the public trust. If development is proposed within these areas, a Commission permit will be required.

5) The Commission may review a desalination plant proposal under consistency authority when it will have impacts on the coastal zone, and either a) a federal agency will be carrying out or funding the project, or b) a federal permit is required for the project (Section 307, Coastal Zone Management Act; 16 U.S.C. Section 1456).

6) The creation of a special district for purposes of funding a desalination facility may be subject to coastal permit or LCP amendment requirements.

Filing Requirements

Section 13053.5 of the Commission's Administrative Regulations list the items that must be included with a coastal development permit application in order for the application to be filed. These items include:

> An adequate description including maps, plans, photographs, etc. of the proposed development, project site and vicinity sufficient to determine whether the project complies with all relevant policies of the California Coastal Act of 1976, including sufficient information concerning land and water areas in the vicinity of the site of the proposed project.... The description of the development shall also include any feasible alternatives or any feasible mitigation measures available that would substantially lessen any significant adverse impact which the development may have on the environment.

The applicant must also demonstrate a legal right, interest or other entitlement to use a property for the proposed development. (Public Resources Code Section 30601.5; 14 CCR, Section 13053(b). This may include a lease or permit from the State Lands Commission (SLC) for use of state lands if the project will be located in the SLC's jurisdiction area. In addition, the applicant should submit with the coastal development permit application evidence that the proposed discharges are authorized by an NPDES permit. If a permit for disposal of solid waste is required, this permit should also be submitted to the Commission with the coastal development permit application. All permits required for a proposed project must be obtained prior to plant operation.

Coastal Dependency

Coastal Act Section 30255 states that coastal-dependent developments shall have priority over other development on or near the shoreline. Coastal Act Section 30260 provides that coastal-dependent industrial facilities shall be encouraged to locate or expand within existing sites. Coastal-dependent industrial developments that are not consistent with other sections of the Coastal Act may be approved under Section 30260 if "1) alternative locations are infeasible or more environmentally damaging; 2) to do otherwise would adversely affect the public welfare; and 3) adverse environmental effects are mitigated to the maximum extent feasible."

The Commission will need to determine, on a case-by-case basis, whether a proposed seawater desalination project is a "coastal-dependent development" and/or a "coastal-dependent industrial development." The Coastal Act defines a coastal-dependent development or use as "any development or use which requires a site on, or adjacent to, the sea to be able to function at all" (Section 30101). Desalination plants that use seawater as feedwater will need to be located fairly near the coast, but not necessarily in the coastal zone.

Desalination Plant Permitting Process - Other Agencies

A municipality or company that intends to construct a desalination plant will also typically be required to obtain the following permits or other approvals from agencies other than the Coastal Commission:

- If the local government (city or county) has a Commission-certified LCP, a coastal development permit pursuant to Section 30600(d) of the Coastal Act for any portion of the project that is not within the Coastal Commission's retained permit jurisdiction, as described above. Prior to obtaining a local permit, the applicant will, in most cases, have to complete a California Environmental Quality Act (CEQA) Document such as an Environmental Impact Report or a Negative Declaration. **[1]**
- A National Pollutant Discharge Elimination System (NPDES) permit to discharge seawater desalination wastes (e.g., brine) issued by the State Regional Water Quality Control Board (RWQCB) with jurisdiction in the area of the proposed project.
- A lease or permit from the State Lands Commission (SLC) for use of state lands if the project will be located in the SLC's jurisdiction area.
- Permits from the U.S. Army Corps of Engineers under Section 10 of the Rivers and Harbors Act of

1899 (33 U.S.C. Section 403) and Section 404 of the Clean Water Act (33 U.S.C. Section 1344).

Other Regulatory Authorities

Agencies other than the Coastal Commission that may have regulatory authority over desalination plants (depending on the location of the proposed development) include the following:

- Air Quality Management Districts
- Bay Conservation and Development Commission
- California Department of Fish and Game
- California Department of Health Services, Office of Drinking Water and Toxic Substances Control Division
- California Department of Parks and Recreation
- California Department of Transportation
- California Energy Commission
- California Public Utilities Commission
- City and County Planning Commissions, City Councils, and Boards of Supervisors
- County Departments of Environmental Health
- National Marine Fisheries Service
- Port Authorities
- Port Districts
- State Department of Water Resources
- State Lands Commission
- State Regional Water Quality Control Boards
- State Water Resources Control Board
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Coast Guard
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Minerals Management Service (for equipment installed on OCS platforms)

Legislative Proposals

- **State of California**

Assemblymember Richard Polanco introduced the following five bills designed to encourage desalination projects in the state.

Assembly Bill 2111 passed both the Senate and the Assembly but was vetoed by the Governor in 1991. The bill was reintroduced as **AB 3111** on February 19, 1992. This bill also passed the Senate and the Assembly but was vetoed by the Governor in 1992. AB 3111 would have authorized owners or operators of qualifying desalination facilities (a plant owned or operated by a private or not-for-profit entity that has a production capacity of at least 400,000 gpd) to request a local water agency to provide physical connections between the qualifying desalting facility and the water distribution system of the local water agency and to purchase water desalted in the facility. Following an opportunity for public comments, the water agency would determine whether or not to grant the request, based on whether connection to the desalination plant would result in equal or improved water quality and supply, would not provide water in excess of the amount purchased by the water agency's customers, and would not displace water that could be purchased at a lower actual cost for longer than a two-year period. If the water agency decided to purchase the desalinated water, any difference in price paid for the water would have been incorporated into the water agency's overall rate structure. A qualifying facility would not have been considered a public utility solely because of conducting activities provided for in the bill.

Assembly Bill 2112 was initially designed as a bond act to provide $800 million for financing a water desalination program. This bill, which was not supported by 2/3 of the Assembly, was amended to provide a framework for submission to the voters of a bond act to provide $1 billion to finance a state desalination program. The amended bill needed only a majority vote because it would not have approved a bond measure. The bill passed the Assembly but was held in the Senate Agriculture and Water Resources Committee.

Assembly Bill 2113 was not heard in committee and was not be reintroduced in 1992. It would have required the Department of Water Resources (DWR) to provide electric power to a public or private desalination facility at the unit cost of electric power applicable to facilities in the State Water Resources Development System.

Assembly Bill 2206 would have created the California Desalination Authority to develop standards for desalination facilities, promote development and use of desalination, review advances in the technology, and coordinate with public agencies. The bill, which would have been funded by the bond measure initially included in AB 2112, was no longer feasible when the bond measure did not succeed.

Assembly Bill 2207, amended July 18, 1991, was signed by the Governor in October 1991 (Chapter 1161, Statutes of 1991). It declares that the cessation of, or reduction in, the use of water as the result of the use of desalinated water constitutes a reasonable, beneficial use of water. It requires the DWR to provide assistance to persons or entities that plan to construct desalination plants.

Assemblymember Peace introduced **AB 1013** which passed both the Senate and the Assembly but was vetoed by the Governor. The bill, as amended September 10, 1991, would have required the Public Utilities Commission and the Energy Commission to consider electric utility company proposals to further the development of desalination plants. The bill would have provided for the expeditious review of a proposal for a pilot project that demonstrates the compatibility between the repowering of a major coastal electric power plant and the construction of a companion desalination facility. The electric utility would have had to demonstrate the need for at least 200 MW of additional capacity. The repowered plant would have had to produce between 200 and 475 MW, and the desalination plant would have had to generate at least 10 MGD of water. An incorporated county water authority would have been required to participate in the project. The bill would have been repealed on January 1, 1994, unless a pilot project that met the criteria of the bill was licensed by that date.

State Senator Thompson introduced **SB 1087** which, as amended May 13, 1991, would have provided for submission to the voters of a bond act to provide $300 million to finance desalination projects. The bill did not make it out of the Senate. SB 1087 was incorporated into another bill, **SB 1182**, which is a wastewater reclamation bond act, and the amount that would be allocated for desalination was reduced to $100 million. SB 1182 was signed by the Governor in October 1991 (Chapter 1142, Statutes of 1991).

- **Federal**

In March 1993, Senator Paul Simon of Illinois introduced U.S. Senate Bill **S. 617** "to authorize research into the desalination of water and water reuse and to authorize a program for States, cities, or any qualifying agency which desires to own and operate a desalination or water reuse facility to develop such facilities." The bill would provide funds for research and development in the amounts of $5 million for fiscal year (FY) 1994, $10 million for FY 1995, and additional funds as necessary for FY 1996-1998. An additional $50 million over a five-year period would be made available equally to the Department of the Interior or the Army Corps of Engineers for design and construction of desalination facilities.

President Bush's fiscal year 1992 budget included $1 million for the Bureau of Reclamation for the start of a new desalting and related water treatment program.

ENDNOTES

1. Pursuant to Section 21080(b)(4) of the CEQA, if an emergency develops, the requirements for preparing an EIR prior to construction of a desalination plant may not apply. A coastal development permit from the Coastal Commission and/or the local government with jurisdiction in the area of the proposed plant, however, will still be required.

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CHAPTER FIVE: *RECOMMENDATIONS*

Recommendations for Coastal Commission Staff Review of Desalination Projects

The purpose of these recommendations is to provide guidance to: 1) applicants proposing desalination projects, and 2) the Coastal Commission staff in working with applicants and reviewing applications for permits for desalination plants. The Coastal Act and LCPs are the standards for review of permit applications. All the technical information needed and the permits required from other agencies should be provided by the applicant when a permit application is filed. In addition, the Coastal Commission headquarters' and districts' staffs will work closely together to ensure that consistent standards of review are applied statewide.

Early Involvement in Scoping Alternatives

The Coastal Commission staff should become involved in a desalination project proposal as early as possible in applicable planning processes, including but not limited to those mandated under CEQA and/or NEPA, before the decision to build a plant is final. Desalination proposals should be considered in the context of an overall water management plan. For example, all opportunities for water conservation and reclamation should be implemented in the area proposing to build a desalination plant. In addition, water supply alternatives such as drawing water from an existing aqueduct or reservoir should be considered. Alternative sites and alternative desalination technologies should be fully considered so that potential adverse environmental impacts from the plant can be avoided or minimized.

Impacts from Energy Use

Applicants for desalination projects are encouraged to consider possibilities for cogeneration, alternative energy technologies, and technologies that reduce energy use. The applicants should submit estimates of the projected annual energy use and the environmental impacts that will result from this energy production. For plants that will require significant new electricity generation, the staff should work with the local Air Pollution Control District (APCD) to ensure that adequate offsets will be provided if required. In these cases, applicants should submit with the permit application evidence of compliance with air pollution control laws for emissions from the electricity generation.

Seawater Intake

Desalination plants can use either a pipeline into the ocean or beach wells for intake of seawater. Beach wells have the significant advantage of eliminating impingement and entrainment impacts. Applicants are encouraged to use beach wells for seawater intake whenever feasible, and where the wells will not cause significant adverse impacts to either beach topography or potable groundwater supplies.

Use of Hazardous Chemicals

Applicants are encouraged to select technologies and processes that minimize or eliminate the discharges of hazardous constituents into the ocean. The applicant should ensure that the least environmentally damaging options for feedwater treatment and cleaning of plant components are selected.

Combining Brine with Other Discharges

Applicants should evaluate the options for combining brine discharges with discharges from a power plant or a sewage treatment plant. Combining the brine with power plant cooling water discharges is probably the form of ocean discharge that will have the least damaging impacts because the brine would be diluted. Mixing with sewage treatment effluent may also be preferable to direct discharges of brine, but more information is needed.

When the brine will be combined with other discharges, the applicant should clearly identify which party or parties will be responsible for monitoring the discharges and for providing corrective measures for any adverse impacts that occur. When more than one party is involved in discharging the effluent, the staff may require co-applicancy for the permit.

Impacts of Discharges

Applicants should provide as much information as possible about the potential impacts to marine resources from the proposed discharges. This information may be obtained from pre-operational monitoring, monitoring results from other desalination plants, and pilot plant studies conducted before building a full-scale plant. The information should be reviewed by the Coastal Commission staff in consultation with the RWQCB with jurisdiction in the area where the plant will be located.

The Commission staff will need to consider the information contained in the NPDES permit as part of its review of the coastal development permit application. The staff should work with the RWQCB to ensure that the applicant will provide the pre- and post-operational monitoring information needed to evaluate the marine resource impacts of the plant. The coastal development permit should require that 1) the Executive Director receive copies of all monitoring reports submitted to the RWQCB, so that the staff may evaluate the marine resource impacts of these plants and 2) the applicant provide evidence to the Executive Director of NPDES permit renewals for discharges from the plant.

The Commission staff should review monitoring information provided by the desalination plant operator and, to the extent permitted by Section 30412 of the Coastal Act, either strengthen existing regulatory requirements to minimize or eliminate any adverse impacts that such information documents or modify the monitoring requirements to improve the information collected on a particular problem. In the alternative, the staff should work with the SWRCB and RWQCBs and their respective staffs pursuant to Section 30404 of the Coastal Act to accomplish these same objectives.

Subject to the limitations maintained in Section 30412 of the Coastal Act, if the Commission staff believes that the RWQCB's monitoring requirements are not adequate to provide the information needed to evaluate the marine resource impacts of a plant, the staff should include permit conditions that specify the additional information needed.

Potential Growth-Inducing Impacts

In evaluating a proposal for a desalination plant, the Commission staff should consider whether the water provided will meet only the existing needs of the community or private development or will provide additional water supplies, which may allow opportunities for growth. Water supplies made available through a desalination plant should be no more than the level to support development potentially allowable under the certified LCP.

If an applicant submits a proposal to build a desalination plant to meet emergency water supply shortfalls, the staff should evaluate the proposal to determine if the plant is designed in a manner that will allow for easy removal of the structure with minimal environmental impacts after the emergency has passed. The permit should include a condition that stipulates the time for which the permit is valid and that requires the applicant to apply for a new permit to extend the life of the plant if required. The permit should specify the permitted capacity of the plant; the applicant must subsequently comply with the capacity limitation stated.

Periodic Reviews of LCPs

As part of periodic reviews of LCPs in water-short areas, the Commission staff should consider water supply issues and potential growth-inducing impacts from water supply. LCPs should encourage use of conservation and reclamation measures to reduce the need for new water projects. LCPs should also specify the quantity of water supplies that will be needed for the planned levels of development.

Cumulative Impacts

Applicants for desalination projects should evaluate cumulative impacts in their Environmental Impact Reports. The Commission staff will work with local and state agencies to consider the potential cumulative impacts of desalination projects. Among the important issues to consider are: the impacts from building a number of small plants versus a few larger ones; the potential impacts of short-term projects if they continue to operate in the long term; the potential impacts on growth from the additional water supplied by a number of projects; and the environmental effects of additional power production if needed for operation of desalination plants.

Recommendations for Consideration by the Coastal Commission

- **Water Supply Options**

The Coastal Commission, local governments, the Department of Water Resources, and other agencies should establish criteria for determining when a desalination project is appropriate for supplying water, and when alternative water supply options are preferable. The Commission should encourage local entities to use all options for water reclamation and conservation.

- **Interagency Task Force**

The Commission should consider establishing and/or participating in an interagency task force to address issues surrounding desalination. The task force should include agencies such as the Bay Conservation and Development Commission, the Department of Fish and Game, the Department of Water Resources, Regional Water Quality Control Boards, the State Water Resources Control Board, and other local, state, and federal agencies, local governments, and water management agencies.

- **Information on Effects of Discharges**

The Commission should encourage research on the marine resource and water quality impacts of discharges from desalination plants.

- **Private versus Public Ownership**

Water is often the limiting factor for potential development projects and growth within a community. Because public ownership and operation of desalination plants may be a significant contributing factor in ensuring that initial development of desalination plants and subsequent water allocations are consistent with the development priorities mandated in the Coastal Act or incorporated in a certified LCP, the Commission should evaluate whether special or additional conditions may be necessary or appropriate in connection with any approvals it may grant to privately-owned desalination plants.

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